

CBSE & State Boards

UNSOLVED PAPERS

CHEMISTRY

CHAPTER WISE

& SUB- TOPICWISE

Question Bank

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CONTENT

Chapter-:1 Solid State	12-34
I. General Characteristics of Solid State.....	12
Section-A (Multiple Choice Questions)	12
Section-B (Very Short Answer)	12
Section-C (Short Answer)	13
Section-E (Long Answer).....	13
II. Amorphous and Crystalline Solids.....	13
Section-A (Multiple Choice Questions)	13
Section-B (Very Short Answer)	14
Section-C (Short Answer)	14
Section-D (Case Based Study)	14
Section-E (Long Answer).....	14
III. Crystal Lattices and Unit Cells	15
Section-A (Multiple Choice Questions)	15
Section-B (Very Short Answer)	15
Section-C (Short Answer)	16
IV. No. of Atoms in a Unit Cell.....	17
Section-A (Multiple Choice Questions)	17
Section-B (Very Short Answer)	18
Section-C (Short Answer)	19
V. Close Packed Structures.....	19
Section-A (Multiple Choice Questions)	19
Section-B (Very Short Answer)	20
Section-C (Short Answer)	21
Section-E (Long Answer).....	21
VI.Packing Efficiency.....	22
Section-A (Multiple Choice Questions)	22
Section-B (Very Short Answer)	22
Section-C (Short Answer)	22
Section-E (Long Answer).....	22
VII.Calculation Involving Unit Cell.....	23
Section-A (Multiple Choice Questions)	23
Section-B (Very Short Answer)	23
Section-C (Short Answer)	25
Section-D (Case Based Study)	27
Section-E (Long Answer).....	27
VIII.Imperfections in Solids.....	27
Section-A (Multiple Choice Questions)	27
Section-B (Very Short Answer)	28
Section-C (Short Answer)	30
Section-E (Long Answer).....	31
IX.Electrical and Magnetic Properties	31
Section-A (Multiple Choice Questions)	31
Section-B (Very Short Answer)	32
Section-C (Short Answer)	33
Section-E (Long Answer).....	34
Chapter-: 2 Solutions	35-67
I. Types of Solutions.....	35
Section-A (Multiple Choice Questions)	35
Section-B (Very Short Answer)	36
Section-C (Short Answer)	36
Section-E (Long Answer).....	37
II. Expression of Concentration of solution	37
Section-A (Multiple Choice Questions)	37
Section-B (Very Short Answer)	38
Section-C (Short Answer)	40
Section-E (Long Answer).....	42

III. Solubility.....	42
Section-A (Multiple Choice Questions).....	42
Section-B (Very Short Answer).....	42
Section-C (Short Answer).....	42
Section-E (Long Answer).....	43
IV. Colligative Properties and Determination of Molar Mass	43
Section-A (Multiple Choice Questions).....	43
Section-B (Very Short Answer)	44
Section-C (Short Answer)	45
Section-D (Case Based Study)	49
Section-E (Long Answer).....	50
V. Vapour Pressure of Liquid Solutions.....	51
Section-A (Multiple Choice Questions).....	51
Section-B (Very Short Answer)	52
Section-C (Short Answer)	53
Section-D (Case Based Study)	55
Section-E (Long Answer).....	55
VI. Osmotic Pressure	56
Section-A (Multiple Choice Questions)	56
Section-B (Very Short Answer)	57
Section-C (Short Answer)	59
Section-E (Long Answer).....	61
VII. Ideal and non Ideal Solution.....	62
Section-A (Multiple Choice Questions)	62
Section-B (Very Short Answer)	63
Section-C (Short Answer)	64
Section-E (Long Answer).....	65
VIII. Abnormal Molar Masses.....	65
Section-A (Multiple Choice Questions)	65
Section-B (Very Short Answer)	65
Section-C (Short Answer)	66
Section-E (Long Answer).....	67
Chapter:- 3 Electrochemistry	68-103
I. Electrochemical Cells.....	68
Section-A (Multiple Choice Questions)	68
Section-B (Very Short Answer)	69
Section-C (Short Answer)	71
Section-D (Case Based Study)	72
Section-E (Long Answer).....	72
II. Galvanic Cells	74
Section-A (Multiple Choice Questions)	74
Section-B (Very Short Answer)	75
Section-C (Short Answer)	75
Section-D (Case Based Study)	76
Section-E (Long Answer).....	77
III. Nernst Equation	77
Section-A (Multiple Choice Questions)	77
Section-B (Very Short Answer)	78
Section-C (Short Answer)	79
Section-E (Long Answer).....	83
IV. Conductance of Electrolytic Solutions.....	84
Section-A (Multiple Choice Questions)	84
Section-B (Very Short Answer)	86
Section-C (Short Answer)	88
Section-D (Case Based Study)	91
Section-E (Long Answer).....	91
V. Electrolysis and Electrolytic Cells.....	93
Section-A (Multiple Choice Questions)	93
Section-B (Very Short Answer)	94
Section-C (Short Answer)	95
Section-E (Long Answer).....	97
VI. Batteries	99
Section-A (Multiple Choice Questions)	99
Section-B (Very Short Answer)	100
Section-C (Short Answer)	100
Section-E (Long Answer).....	100

VII. Fuel Cells	100
Section-A (Multiple Choice Questions)	100
Section-B (Very Short Answer)	101
Section-C (Short Answer)	102
Section-E (Long Answer).....	102
VIII.Corrosion.....	103
Section-A (Multiple Choice Questions)	103
Section-B (Very Short Answer)	103
Section-C (Short Answer)	103
Section-D (Case Based Study)	103
Section-E (Long Answer).....	103
Chapter-: 4 Chemical Kinetics	104-134
I. Rate of Chemical Reaction.....	104
Section-B (Very Short Answer)	104
Section-C (Short Answer)	104
Section-E (Long Answer).....	105
II. Rate Law and Rate Constant.....	105
Section-A (Multiple Choice Questions)	105
Section-B (Very Short Answer)	106
Section-C (Short Answer)	107
Section-D (Case Based Study)	108
Section-E (Long Answer).....	108
III. Order of reaction, Molecularity.....	110
Section-A (Multiple Choice Questions)	110
Section-B (Very Short Answer)	112
Section-C (Short Answer)	116
Section-D (Case Based Study)	120
Section-E (Long Answer).....	121
IV. Integrated Rate Equations and Half Life	123
Section-A (Multiple Choice Questions)	123
Section-B (Very Short Answer)	125
Section-C (Short Answer)	126
Section-D (Case Based Study)	128
Section-E (Long Answer).....	128
V. Arrhenius Equation.....	130
Section-A (Multiple Choice Questions)	130
Section-B (Very Short Answer)	130
Section-C (Short Answer)	131
Section-E (Long Answer).....	132
VI. Factor Affecting Rate of Reactions.....	133
Section-A (Multiple Choice Questions)	133
Section-B (Very Short Answer)	133
Section-C (Short Answer)	133
Section-E (Long Answer).....	134
VII.Collision Theory of Chemical Reactions	134
Section-A (Multiple Choice Questions)	134
Section-B (Very Short Answer)	134
Section-C (Short Answer)	134
Section-E (Long Answer).....	134
5. Surface Chemistry	135
I. Homogenous and Heterogeneous Catalysis.....	135
Section-A (Multiple Choice Questions)	135
Section-B (Very Short Answer)	135
Section-C (Short Answer)	135
Section-E (Long Answer).....	136
II. Adsorption	136
Section-A (Multiple Choice Questions)	136
Section-B (Very Short Answer)	137
Section-C (Short Answer)	139
Section-E (Long Answer).....	140
III. Catalysis.....	141
Section-A (Multiple Choice Questions)	141
Section-B (Very Short Answer)	141
Section-C (Short Answer)	142
Section-E (Long Answer).....	143

IV. Colloids and Classification of Colloids	143
Section-A (Multiple Choice Questions).....	143
Section-B (Very Short Answer).....	145
Section-C (Short Answer).....	147
Section-D (Case Based Study).....	150
Section-E (Long Answer).....	151
V. Emulsions.....	152
Section-A (Multiple Choice Questions).....	152
Section-B (Very Short Answer).....	152
Section-C (Short Answer).....	153
Section-E (Long Answer).....	153
Chapter:- 6 General Principles and Processes of Isolation of Elements.....	154-170
I. Occurrence of Metals.....	154
Section-A (Multiple Choice Questions).....	154
Section-B (Very Short Answer).....	154
Section-C (Short Answer).....	155
II. Concentration of Ores	155
Section-A (Multiple Choice Questions).....	155
Section-B (Very Short Answer).....	155
Section-C (Short Answer).....	156
Section-E (Long Answer).....	157
III. Extraction of Crude Metal from Concentrated Ore	158
Section-A (Multiple Choice Questions).....	158
Section-B (Very Short Answer).....	159
Section-C (Short Answer).....	161
Section-D (Case Based Study).....	161
Section-E (Long Answer).....	163
IV. Electrochemical Principles of Metallurgy	164
Section-A (Multiple Choice Questions).....	164
Section-B (Very Short Answer).....	164
Section-C (Short Answer).....	165
Section-E (Long Answer).....	166
V. Oxidation and Reduction.....	166
Section-A (Multiple Choice Questions).....	166
Section-B (Very Short Answer).....	166
Section-C (Short Answer).....	166
Section-E (Long Answer).....	166
VI. Refining.....	167
Section-A (Multiple Choice Questions).....	167
Section-B (Very Short Answer).....	167
Section-C (Short Answer).....	168
Section-E (Long Answer).....	170
Chapter:- 7 P-Block Elements	171-211
I. Boron Family (Group 13-Elements).....	171
Section-A (Multiple Choice Questions).....	171
Section-B (Very Short Answer)	171
Section-C (Short Answer).....	172
Section-E (Long Answer).....	172
II. Carbon Family (Group 14-Elements).....	172
Section-A (Multiple Choice Questions).....	172
Section-B (Very Short Answer)	172
Section-C (Short Answer).....	173
Section-E (Long Answer).....	173
III. Allotropes of Carbon	173
Section-A (Multiple Choice Questions).....	173
Section-B (Very Short Answer)	173
Section-C (Short Answer).....	173
IV. Nitrogen Family (Group 15-Elements)	174
Section-A (Multiple Choice Questions).....	174
Section-B (Very Short Answer)	176
Section-C (Short Answer).....	180
Section-D (Case Based Study)	183
Section-E (Long Answer).....	183

V. Oxygen Family (Group 16-Elements)	186
Section-A (Multiple Choice Questions)	186
Section-B (Very Short Answer)	187
Section-C (Short Answer)	191
Section-D (Case Based Study)	194
Section-E (Long Answer).....	194
VI. Halogen Family (Group 17-Elements)	196
Section-A (Multiple Choice Questions)	196
Section-B (Very Short Answer)	198
Section-C (Short Answer)	201
Section-D (Case Based Study)	203
Section-E (Long Answer).....	204
VII.Noble Family (Group 18-Elements)	206
Section-A (Multiple Choice Questions)	206
Section-B (Very Short Answer)	207
Section-C (Short Answer)	209
Section-D (Case Based Study)	210
Section-E (Long Answer).....	211
Chapter-: 8 d-and-f Block Elements	212-242
I. Electronic Configuration of d-block Elements.....	212
Section-A (Multiple Choice Questions)	212
Section-B (Very Short Answer)	212
Section-C (Short Answer)	212
Section-E (Long Answer).....	213
II. Oxidation State of Transition Elements.....	213
Section-A (Multiple Choice Questions)	213
Section-B (Very Short Answer)	214
Section-C (Short Answer)	214
Section-E (Long Answer).....	216
III. General Properties of the Transition Elements	217
Section-A (Multiple Choice Questions)	217
Section-B (Very Short Answer)	220
Section-C (Short Answer)	222
Section-D (Case Based Study)	230
Section-E (Long Answer).....	230
IV. The Lanthanoids.....	232
Section-A (Multiple Choice Questions)	232
Section-B (Very Short Answer)	233
Section-C (Short Answer)	234
Section-D (Case Based Study)	235
Section-E (Long Answer).....	235
V. The Actionoids.....	236
Section-A (Multiple Choice Questions)	236
Section-B (Very Short Answer)	236
Section-C (Short Answer)	237
Section-D (Case Based Study)	237
Section-E (Long Answer).....	237
VI. Some Applications of d-and-f Block Elements.....	237
Section-A (Multiple Choice Questions)	237
Section-B (Very Short Answer)	238
Section-C (Short Answer)	239
Section-E (Long Answer).....	241
Chapter-: 9 Coordinations Compounds.....	243-270
I. Werner's Theory of Coordination Compounds	243
Section-A (Multiple Choice Questions)	243
Section-B (Very Short Answer)	243
Section-C (Short Answer)	244
Section-E (Long Answer).....	245
II. Nomenclature of Coordination Compounds.....	245
Section-A (Multiple Choice Questions)	245
Section-B (Very Short Answer)	246
Section-C (Short Answer)	249
Section-E (Long Answer).....	251

III. General Properties of Coordination compound	252
Section-A (Multiple Choice Questions)	252
Section-B (Very Short Answer)	254
Section-C (Short Answer)	256
Section-D (Case Based Study)	258
Section-E (Long Answer).....	259
IV. Bonding in Coordination Compounds.....	260
Section-A (Multiple Choice Questions)	260
Section-B (Very Short Answer)	260
Section-C (Short Answer)	260
Section-E (Long Answer).....	261
V. Bonding in Metal Carbonyl.....	261
Section-A (Multiple Choice Questions)	261
Section-B (Very Short Answer)	261
Section-C (Short Answer)	261
Section-E (Long Answer).....	261
VI. Isomerism in Coordination Compound	261
Section-A (Multiple Choice Questions)	261
Section-B (Very Short Answer)	263
Section-C (Short Answer)	264
Section-E (Long Answer).....	266
VII. Application of Coordination Compounds	266
Section-A (Multiple Choice Questions)	266
Section-B (Very Short Answer)	268
Section-C (Short Answer)	268
Section-E (Long Answer).....	270
Chapter-: 10 Haloalkanes and Haloarenes.....	271-294
I. Nomenclature.....	271
Section-A (Multiple Choice Questions)	271
Section-B (Very Short Answer)	271
Section-C (Short Answer)	273
Section-E (Long Answer).....	273
II. Preparation of Haloalkanes	273
Section-A (Multiple Choice Questions)	273
Section-B (Very Short Answer)	274
Section-C (Short Answer)	275
Section-E (Long Answer).....	276
III. Properties of Haloalkanes.....	276
Section-A (Multiple Choice Questions)	276
Section-B (Very Short Answer)	277
Section-C (Short Answer)	280
Section-D (Case Based Study)	284
Section-E (Long Answer).....	284
IV. Preparation of Haloarenes.....	284
Section-A (Multiple Choice Questions)	284
Section-B (Very Short Answer)	285
Section-C (Short Answer)	285
Section-E (Long Answer).....	285
V. Properties of Haloarenes.....	285
Section-A (Multiple Choice Questions)	285
Section-B (Very Short Answer)	285
Section-C (Short Answer)	285
Section-E (Long Answer).....	286
VI. Chemical Reactions.....	286
Section-A (Multiple Choice Questions)	286
Section-B (Very Short Answer)	287
Section-C (Short Answer)	288
Section-D (Case Based Study)	290
Section-E (Long Answer).....	291
VII.Polyhalogen Compounds	293
Section-A (Multiple Choice Questions)	293
Section-B (Very Short Answer)	294
Section-C (Short Answer)	294
Section-E (Long Answer).....	294

Chapter:- 11 Alcohols, Phenols and Ethers.....	295-323
I. Nomenclature	295
Section-A (Multiple Choice Questions).....	295
Section-B (Very Short Answer)	295
Section-C (Short Answer)	297
II. Preparation of Alcohol, Phenols.....	297
Section-A (Multiple Choice Questions).....	297
Section-B (Very Short Answer)	298
Section-C (Short Answer)	299
Section-E (Long Answer).....	300
III. Reaction of Alcohol and Phenol.....	301
Section-A (Multiple Choice Questions).....	301
Section-B (Very Short Answer)	303
Section-C (Short Answer)	305
Section-D (Case Based Study)	309
Section-E (Long Answer).....	309
IV. Properties of Alcohol.....	312
Section-A (Multiple Choice Questions).....	312
Section-B (Very Short Answer)	313
Section-C (Short Answer)	315
Section-E (Long Answer).....	318
V. Ethers	319
Section-A (Multiple Choice Questions).....	319
Section-B (Very Short Answer)	320
Section-C (Short Answer)	322
Section-D (Case Based Study)	323
Section-E (Long Answer).....	323
Chapter:- 12 Aldehydes, Ketones and Carboxylic Acids.....	324-373
I. Nomenclature of Carbonyl Group.....	324
Section-A (Multiple Choice Questions).....	324
Section-B (Very Short Answer)	324
Section-C (Short Answer)	325
Section-E (Long Answer).....	325
II. Preparation of Aldehydes and Ketones.....	325
Section-A (Multiple Choice Questions).....	325
Section-B (Very Short Answer)	326
Section-C (Short Answer)	327
Section-D (Case Based Study)	328
Section-E (Long Answer).....	328
III. Reaction of Aldehydes and Ketones	328
Section-A (Multiple Choice Questions).....	328
Section-B (Very Short Answer)	330
Section-C (Short Answer)	333
Section-D (Case Based Study)	337
Section-E (Long Answer).....	338
IV. Chemical and Physical Properties of Aldehydes and Ketones	343
Section-A (Multiple Choice Questions).....	343
Section-B (Very Short Answer)	343
Section-C (Short Answer)	344
Section-D (Case Based Study)	346
Section-E (Long Answer).....	346
V. Nomenclature of Carboxyl Group	347
Section-A (Multiple Choice Questions).....	347
Section-B (Very Short Answer)	348
Section-C (Short Answer)	348
Section-E (Long Answer).....	348
VI. Method of Preparation of Carboxylic Acids.....	348
Section-A (Multiple Choice Questions).....	348
Section-B (Very Short Answer)	349
Section-C (Short Answer)	350
Section-D (Case Based Study)	352
Section-E (Long Answer).....	353

VII. Chemical and Physical Properties of Carboxylic Acid	354
Section-A (Multiple Choice Questions)	354
Section-B (Very Short Answer)	355
Section-C (Short Answer)	357
Section-D (Case Based Study)	359
Section-E (Long Answer).....	360
VIII.Uses of Aldehydes, Ketones and Carboxylic Acids	361
Section-A (Multiple Choice Questions)	361
Section-B (Very Short Answer)	361
Section-C (Short Answer)	364
Section-E (Long Answer).....	367
Chapter:- 13 Organic Compounds Containing Nitrogen	374
I. Structure and Identification of Amines.....	374
Section-A (Multiple Choice Questions)	374
Section-B (Very Short Answer)	374
Section-C (Short Answer)	375
Section-E (Long Answer).....	376
II. Nomenclature	376
Section-A (Multiple Choice Questions)	376
Section-B (Very Short Answer)	376
Section-C (Short Answer)	377
Section-E (Long Answer).....	377
III. Preparation of Amines.....	377
Section-A (Multiple Choice Questions)	377
Section-B (Very Short Answer)	378
Section-C (Short Answer)	380
Section-D (Case Based Study)	380
Section-E (Long Answer).....	380
IV. Physical and Chemical Properties of Amines	380
Section-A (Multiple Choice Questions)	380
Section-B (Very Short Answer)	382
Section-C (Short Answer)	384
Section-D (Case Based Study)	386
Section-E (Long Answer).....	387
V. Chemical Reaction.....	388
Section-A (Multiple Choice Questions)	388
Section-B (Very Short Answer)	389
Section-C (Short Answer)	390
Section-D (Case Based Study)	393
Section-E (Long Answer).....	393
VI. Method of Preparation of Diazonium Salts	395
Section-A (Multiple Choice Questions)	395
Section-B (Very Short Answer)	395
Section-C (Short Answer)	395
Section-E (Long Answer).....	396
VII. Importance of Diazonium Salt and Synthesis of Aromatic Compound	396
Section-A (Multiple Choice Questions)	396
Section-B (Very Short Answer)	398
Section-C (Short Answer)	398
Section-E (Long Answer).....	399
Chapter:- 14 Biomolecules	400-425
I. Carbohydrates.....	400
Section-A (Multiple Choice Questions)	401
Section-B (Very Short Answer)	403
Section-C (Short Answer)	406
Section-D (Case Based Study)	409
Section-E (Long Answer).....	409
II. Vitamins	411
Section-A (Multiple Choice Questions)	411
Section-B (Very Short Answer)	412
Section-C (Short Answer)	414
Section-E (Long Answer).....	414
III. Proteins.....	414
Section-A (Multiple Choice Questions)	414
Section-B (Very Short Answer)	415
Section-C (Short Answer)	417
Section-D (Case Based Study)	418
Section-E (Long Answer).....	418

IV. Enzyme	418
Section-A (Multiple Choice Questions)	418
Section-B (Very Short Answer)	418
Section-C (Short Answer)	419
Section-E (Long Answer).....	419
V. Nucleic Acids.....	419
Section-A (Multiple Choice Questions)	419
Section-B (Very Short Answer)	420
Section-C (Short Answer)	421
VI. Amino Acids.....	421
Section-A (Multiple Choice Questions)	421
Section-B (Very Short Answer)	423
Section-C (Short Answer)	423
Section-E (Long Answer).....	425
Chapter-: 15 Polymers	426
I. Classification of Polymers.....	426
Section-A (Multiple Choice Questions)	426
Section-B (Very Short Answer)	427
Section-C (Short Answer)	429
Section-E (Long Answer).....	432
II. Types of Polymerisation Reactions	432
Section-A (Multiple Choice Questions)	432
Section-B (Very Short Answer)	433
Section-C (Short Answer)	435
Section-E (Long Answer).....	439
III. Biodegradable and Non-Biodegradable Polymers.....	440
Section-A (Multiple Choice Questions)	440
Section-B (Very Short Answer)	441
Section-C (Short Answer)	442
Section-E (Long Answer).....	443
IV. Molecular Mass of Polymers	444
Section-A (Multiple Choice Questions)	444
Section-B (Very Short Answer)	444
Section-C (Short Answer)	444
Section-D (Case Based Study)	444
V. Importance of Polymers.....	445
Section-A (Multiple Choice Questions)	445
Section-B (Very Short Answer)	445
Section-C (Short Answer)	445
Section-E (Long Answer).....	445
Chapter-: 16 Chemistry in Everyday Life	446
I. Drugs and Their Classification.....	446
Section-A (Multiple Choice Questions)	446
Section-B (Very Short Answer)	448
Section-C (Short Answer)	450
Section-D (Case Based Study)	454
Section-E (Long Answer).....	454
II. Dyes and Pigment	455
Section-A (Multiple Choice Questions)	455
Section-B (Very Short Answer)	455
Section-C (Short Answer)	455
III. Chemicals in Food	455
Section-A (Multiple Choice Questions)	455
Section-B (Very Short Answer)	456
Section-C (Short Answer)	457
Section-D (Case Based Study)	458
Section-E (Long Answer).....	458
IV. Cleansing Agent.....	458
Section-A (Multiple Choice Questions)	458
Section-B (Very Short Answer)	459
Section-C (Short Answer)	461
Section-E (Long Answer).....	462
V. Importance and Uses.....	462
Section-A (Multiple Choice Questions)	462
VI. Crystal Lattices and Unit Cells	462
Section-B (Very Short Answer)	462
Section-C (Short Answer)	463
Section-E (Long Answer).....	464

Syllabus

Unit II: Solutions

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoult's law, colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, Van't Hoff factor.

Unit III: Electrochemistry

Redox reactions, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, fuel cells, corrosion. CLASS XII (2024-25) (THEORY)

Unit IV: Chemical Kinetics

Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order reactions), concept of collision theory (elementary idea, no mathematical treatment), activation energy, Arrhenius equation.

Unit VIII: d and f Block Elements

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of K₂Cr₂O₇ and KMnO₄. Lanthanoids - Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences. Actinoids - Electronic configuration, oxidation states and comparison with lanthanoids.

Unit IX: Coordination Compounds

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT; structure and stereoisomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological system).

Unit X: Haloalkanes and Haloarenes.

Haloalkanes: Nomenclature, nature of C–X bond, physical and chemical properties, optical rotation mechanism of substitution reactions. Haloarenes: Nature of C–X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only). Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

Unit XI: Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to methanol and ethanol. Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols. Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

Unit XII: Aldehydes, Ketones and Carboxylic Acids

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses. Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Unit XIII: Amines

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines. Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Unit XIV: Biomolecules

Carbohydrates - Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates. Proteins -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes. Hormones - Elementary idea excluding structure. Vitamins - Classification and functions. Nucleic Acids: DNA and RNA.

14. Give an example each of a molecular solid and and ionic solid.
All India-2016
15. What is molecular crystal? Give example.
Tamil Nadu Board-2011
16. Solids have volume and shape.
Haryana Board-2021
17. Write any two characteristics of molecular solids.
Goa Board-2018
18. Classify the following solids as metallic, molecular, ionic or covalent solids:
 (a) Sodium Chloride
 (b) Silica
19. Draw a neat labelled diagram of a tetrahedral void observed in a crystal lattice.
Goa Board-2019
20. Write any one example of network solid.
Rajasthan Board-2019
21. At low temperature hydrogen is which type of molecular solid?
Rajasthan Board-2016
22. Fill in the blanks:
 (a) Co-ordination number of Sodium in NaCl is
- MP Board-2016

Section-C : Short Answer

1. Write the properties of ionic crystals.
Tamil Nadu Board-2018
2. Ionic solids are hard and brittle. Explain.
Maharashtra Board-2018
3. Why are solids rigid?
Haryana Board -2016
4. Give any one difference between anisotropy and isotropy nature of solid.
Rajasthan Board-2017
5. Which of the following are polar molecular solids?
 Solid sulphur dioxide, solid ammonia, iodine crystals, graphite, carbon tetrachloride.
Rajasthan Board-2013

Section-E : Long Answer

1. What type of solids are electrical conductors, malleable and ductile?
 "Ionic solids conduct electricity in molten state but not in solid state". Explain.
- Assam Board-2020

B. Amorphous and Crystalline Solids

Section-A : Multiple Choice Questions

1. (a) Which of the following is not a molecular solid?
 (a) N₂
 (b) I₂
 (c) SiC
 (d) CO₂

CBSE-2021

Ans. (b)

2. In a face centered cubic lattice, atom (A) occupies the corner positions and at (B) occupies the face centre positions. If one atom of (B) is missing from the face centered points, the formula of the compound is :
 (a) A₂B₅
 (b) A₂B₃
 (c) AB₂
 (d) A₂B

ISC Board-2017

Ans. (a)

3. Which of the following is not characteristic of crystalline solid?
 (a) Melts at a sharp and characteristic temperature
 (b) Definite characteristic geometrical shape
 (c) Anisotropic in nature
 (d) Pseudo solids or super cooled liquids

Gujarat Board-2021

Ans. (d)

4. Maximum amount of a solid solute that can be dissolved in a given amount of a liquid solvent does not depend upon:
 (a) Pressure
 (b) Temperature
 (c) Nature of solute
 (d) Nature of solvent

Haryana Board-2017

Ans. (a)

5. Amorphous solid is:
 (a) Rubber
 (b) Plastic
 (c) Glass
 (d) All

Haryana Board-2018

Ans. (d)

6. Which type of solid is graphite?
 (a) Ionic
 (b) Molecular
 (c) Metallic
 (d) Covalent

Gujarat Board-2017

Ans. (d) :

7. In which of the following solid substance dispersion forces exist?
 (a) SiO₂
 (b) CO₂
 (c) H₂O
 (d) SO₂

Gujarat Board-2019

Ans. (b)

8. Dry Ice (Solid CO₂) is a/an:
 (a) Ionic crystal
 (b) Covalent crystal
 (c) Molecular crystal
 (d) Metallic crystal

MP Board-2012

Ans. (c)

9. Which one of the following is non-crystalline or amorphous in nature?
 (a) Diamond
 (b) Graphite
 (c) Common salt
 (d) Glass

Jharkhand Board-2023

Ans. (b)

Section-B : Very Short Answer

- What type of defect can arise when Sr^{2+} (as SrCl_2) is added as impurity in ionic solid Na^+Cl^- . Justify your answer.
Manipur Board 2020
- Name the type of crystalline solid, which is electrical insulator in solid state but conduct electricity in aqueous solution.
Karnataka board 2023
- Explain Schottky defect and Frenkel defect.
Uttarakhand Board 2022
- A compound is formed by two elements X and Y. Atoms of the element Y (as anions) make CCP and those of the element X (as cations) occupy all octahedral voids. What is the formula of the compound?
CBSE-2019
- Why are powdered substances more effective adsorbents than their crystalline forms ?
CBSE-2019
- Correct the following statement.
"Molarity of a solution is independent of temperature".
ISC Board-2005
- Mention three differences between crystalline and amorphous solids.
ISC Board-2000
- Explain why graphite is soft and can be used as lubricant?
ISC Board-2009
- Compare the crystals of copper and diamond giving one similarity and one difference.
ISC Board-2010
- Correct the statement : Diamond is crystalline while graphite is amorphous.
ISC Board-2001
- Graphite is anisotropic to electrical conduction. Explain.
ISC Board-2001
- Correct the statement : Graphite has a two-dimensional sheet like structure in which each carbon atom is sp^3 -hybridised.
ISC Board-2005
- The crystal of diamond is made up of while that of calcium chloride is made of
ISC Board-2009
- The crystal of graphite is made up ofwhile that of sodium chloride is made up of.....
ISC Board-2014
- Write three differences between crystalline and amorphous solids.
Odisha Board-2020
- Write two differences between crystalline solids and amorphous solids.
Manipur Board-2017

- Given the differences between crystalline and amorphous solids with respect to shape and melting point.
Karnataka Board-2017
-solids are electrical conductors, malleable and ductile.
Haryana Board-2022
- Given one example of Ionic solid.
Haryana Board-2022
- Write any three differences between crystalline and amorphous solids.
Kerala Board-2022

Section-C : Short Answer

- What are crystalline solids? Give two examples.
Haryana Board-2017
- Write down distinction between crystalline and amorphous solids on the basis of the following properties.
 - Melting point
 - Cleavage property and
 - Order in arrangement of constituent particles
Gujarat Board 2023 (March)
- (a) Write any two differences between crystalline and amorphous solids.
 - Draw the diagram showing impurity defect.
Rajasthan Board-2020
- Define chromophores and auxochromes.
Rajasthan Board-2010
- Define the terms crystalline & amorphous solids.
Haryana Board-2016

Section-D : Case Based Study

- An amorphous solid 'A' which has a crown shaped structure, burns in air to form a gas 'B' which turns lime water milky. 'B' is also produced by roasting of sulphide ores. 'B' undergoes oxidation in the presence of V_2O_5 to give 'C' and to carry out this oxidation low temperature and high pressure is mandatory to get a good yield of 'C'. 'C' is then absorbed in H_2SO_4 to give 'D'. 'D' is then diluted to give a very important compound 'E'. 'E' is largely responsible for the manufacture of variety of compounds in industry. 'E' in concentrated form, when combined with Cu metal, gives compound 'F'.
From this description
 - Elucidate the structure of 'A' to 'F'.
 - Give a balanced chemical equation for the conversion of 'E' to 'F'.
 - Give two important functions of 'E' in the chemical industry.

CBSE-2020

Section-E : Long Answer

- Define Anisotropy. Distinguish between crystalline solids and amorphous solids.
Maharashtra Board-2019

C. Crystal Lattices and Unit Cells

Section-A : Multiple Choice Questions

1. For unit cell BaSO_4 crystal which option for axial angles is correct?
- $\alpha = \beta = \gamma \neq 90^\circ$
 - $\alpha = \beta = 90^\circ \gamma = 120^\circ$
 - $\alpha = \gamma = 90^\circ \beta \neq 90^\circ$
 - $\alpha = \beta = \gamma = 90^\circ$

Gujarat Board 2023 (March)

Ans. (a)

2. Four alternatives are given in each part of this question. Select the correct alternative and write it in your answer book.
- (a) The length of core of an fcc unit cell is a and its atomic radius is r . The relationship between them is

$$(a) r = \left(\frac{\sqrt{3}}{4} \right) a \quad (b) r = \left(\frac{\sqrt{2}}{4} \right) a$$

$$(c) r = \frac{a}{2} \quad (d) r = \left(\frac{\sqrt{4}}{6} \right) a$$

UP Board 2019

Ans. (a)

3. Example of Hexagonal crystal is—
- Diamond
 - Graphite
 - Salt
 - Water

MP Board 2020

Ans. (b)

4. The crystal system having dimensions $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$ is –
- Hexagonal
 - Monoclinic
 - Triclinic
 - Orthorhombic

UP Board 2023

Ans. (d)

5. In a orthorhombic system axis angles, $\alpha = \beta = \gamma$ are –
- equal 90°
 - Less than 90°
 - greater than 90°
 - None of these

Jharkhand Board-2020

Ans. (a)

6. Number of octahedral sites per sphere in FCC structure:
- 1
 - 3
 - 6
 - 4

Haryana Board-2016

Ans. (a)

7. What is the number of atoms in end centered unit cell?
- 4
 - 1
 - 2
 - 6

Gujarat Board-2018

Ans. (c) :

8. What is the number of atoms in face centred unit cell?
- 2
 - 4
 - 6
 - 3

Gujarat Board-2017

Ans. (b)

9. In which crystal system, edge length is not $a \neq b \neq c$?
- Monoclinic
 - Hexagonal
 - Orthorhombic
 - Triclinic

Gujarat Board-2020

Ans. (d)

10. Crystal structure of NaCl is—

- Face centred cubic
- Body centred cubic
- Hexagonal
- Tetrahedral

MP Board-2015

Ans. (a)

Section-B : Very Short Answer

1. What do you understand by Lattice point?

Uttarakhand Board 2022

2. Define crystal lattice.

J&K Board-2020

3. A cube solid is made up of two elements A and B. Element A forms hcp while atoms of element B occupy two-third of the octahedral voids. What is the formula of the solid?

CBSE-2019

4. (a) Atoms of element Q form ccp lattice and those of the element P occupy $\frac{2}{3}$ rd of tetrahedral voids. What is the formula of the compound formed by the elements P and Q?
 (b) What type of stoichiometric defect is shown by KCl and why ?

CBSE-2019

5. For sodium chloride crystal, state

- (i) the type of unit cell.

- (ii) the nature of forces holding the particles together.

- (iii) the geometry of the sodium ions which are arranged around a chloride ion.

ISC Board-2001, 2003

6. Crystals of and have face centered cubic lattices.

ISC Board-2004

7. (i) Name the crystal structure of copper metal.
 (ii) What is the coordination number of copper in its crystalline state?

ISC Board-2013, 2015

8. Express the relationship between atomic radius (r) and the edge length (a) in the fcc unit cell.

Foreign-2014

9. Express the relationship between atomic radius (r) and the edge length (a) in the bcc unit cell.
Foreign-2014
10. Aluminium crystallizes in fcc structure. Atomic radius of the metal is 125 Pm. What is length of the side of the unit cell of the metal?
All India-2013
11. Define the following terms in relation to crystalline solids.
 (a) Unit cell
 (b) Coordination number
 Give one example in each case.
All India-2011
12. An ionic compound AB_2 possesses CaF_2 type crystal structure. Write the coordination number of A^{2+} and B^- ions in crystals AB_2 .
All India-2009C
13. Define primitive unit cells.
All India-2015; Delhi-2009
14. The smallest repeating unit in crystal lattice which when repeated over and over again produces the complete crystal is _____.
Odisha Board-2020
15. Aluminium crystallizes in an FCC structure. Atomic radius of the metal is 125pm. Calculate the edge length of unit cell of the metal.
Karnataka Board-2014
16. (a) Based on the nature of intermolecular forces, classify the following solids.
 (i) SiO_2
 (ii) Ice
 (b) ZnO turns yellow on heating. Why?
Kerala Board-2018
17. Write the value of axial distances and axial angles of triclinic crystal.
Rajasthan Board-2017
18. Fill the blanks:
 (a) There are _____ type of crystal system.
MP Board-2017
19. What is the coordination number of Cs^+ and Cl^- in $CsCl$ structure?
MP Board-2015
20. Define Crystal Lattice.
J & K board-2023
- Section-C : Short Answer
1. Calculate number of particles per unit cell in a FCC crystal.
Haryana Board-2017
- 2.(i) Write two difference between crystalline and amorphous solids.
 (ii) Draw a diagram for anisotropic behaviour of crystalline solids.
Rajasthan Board-2011
3. What are lattice compounds? Write one example of such compounds.
Rajasthan Board-2010
4. Sketch the:
 (a) Simple cube
 (b) Face-centred cube and
 (c) Body centred cube
Tamil Nadu Board-March, 2016
5. (a) Give the significance of a 'lattice point'. Which point defect increases the density of a crystal?
Assam Board-2020
6. Element B crystallizes in body centered cubic (bcc) unit cell. Calculate approximate number of unit cells in 9.2 gm of element B. (Atomic number of B = 23)
Assam Board-2023
7. (a) Aluminium crystallizes in a cubic close-packed structure. Its metallic radius is 125 pm. What is the length of the side of the unit cell?
 (b) Why is potassium chloride sometimes violet instead of pure white?
Meghalaya Board-2018

D. No. of Atoms in a Unit Cell

Section-A : Multiple Choice Questions

8. Sodium metal crystallises in bcc structure. How many unit cell are present in 9.2 g crystal of sodium metal? [Atomic Mass: Na = 23 gmol⁻¹]
 (a) 3.2×10^{24} (b) 1.20×10^{23}
 (c) 2.4×10^{23} (d) 6.022×10^{24}
Gujarat Board 2023 (March)

Ans. 0

9. The number of atoms per unit cell in a body-centred cubic unit cell is
 (a) 4 (b) 2
 (c) 1 (d) 3
CBSE-2021

Ans. (b)

10. Total number of atoms present in Face Centred Cubic unit cell are.....
 (a) 3 (b) 4
 (c) 2 (d) 1
Gujarat Board-2021

Ans. (b)

11. (a) The number of octahedral voids in the unit cell of ccp lattice is:
 (a) 2 (b) 3
 (c) 4 (d) 6
Odisha Board-2023

Ans. (c)

12. The total number of atoms per unit cell in bcc is:
 (a) 3 (b) 1
 (c) 4 (d) 2
Tamil Nadu Board-2018

Ans. (d)

22. Unit cells can be classified into primitive and centered unit cells. Differentiate between primitive and centered unit cells.

Kerala Board-2016

23. Mention the number of atoms in a b.c.c. unit cell.

Assam Board-2017

Section-C : Short Answer

1. Distinguish between Crystal Lattice and Unit Cell.

Uttarakhand Board-2020

2. Sodium metal crystallises in the cubic lattice and edge of the unit cell is 430 pm. Calculate the number of atoms in the unit cell.

(Density of sodium = 0.9623 g.cm^{-3} At. wt. = 23, Avogadro No. $N_A = 6.023 \times 10^{23}$)

UP Board 2019

3. The density of iron crystal is $8.54 \text{ gram cm}^{-3}$. If the edge length of unit cell is 2.8 \AA and atomic mass is 56 gram mol^{-1} , find the number of atoms in the unit cell.

(Given : Avogadro's number = 6.022×10^{23} , $1\text{\AA} = 1 \times 10^{-8} \text{ cm}$).

Maharashtra Board-2018

4. Define unit cell. Calculate the number of particles per unit cell in Body centered cube and Face centered cube.

Kerala Board-2021

5. What is face-centered cubic (f.c.c.) cell? Explain with diagram. Calculate the number of atoms in unit cell.

Chhattisgarh Board-2021

6. How many sodium ions and chloride ions are present in a unit cell of sodium chloride crystal?

ISC Board-2017

7. Calculate the number of atoms in FCC unit cell.

Haryana Board-2016

8. A cubic unit cell made up of X and Y elements. If X present on the corners of the cube and Y are present on centers of faces, of cube then find formula of the compound.

Haryana Board-2018

9. Define the following terms:

(b) Unit Cell

Haryana Board-2018

10. Assuming that atoms are touching each other, calculate the efficiency of packing in case of a crystal for simple cubic metal.

Rajasthan Board-2014

11. A compound forms hexagonal close packed (hcp) structure. What is the total number of voids in 0.5 mol of it? How many of these are tetrahedral voids?

Assam Board-2019

E. Close Packed Structures

Section-A : Multiple Choice Questions

1. Structure of the crystal of sodium chloride is
 (a) body centred cubic (bcc)
 (b) face centred cubic (fcc)
 (c) orthorhombic
 (d) tetragonal

UP Board 2023

Ans. (b)

2. Efficiency of packing in Simple Cubic Lattice is—
 (a) 52.4% (b) 62.4%
 (c) 68% (d) 74%

Rajasthan Board 2022

Ans. (a)

3. A compound formed by elements P and Q Crystallizes in a cubic structure where P atoms are at the corners of a cube and Q atoms are at the face centres. The formula of the compound is:

(a) $P_2 Q_2$ (b) PQ_3
 (c) PQ (d) $P_3 Q$

CBSE-2021

Ans. (b)

4. A compound is formed by two elements P and Q. Atoms of the element Q (as anions) make CCP and those of the element P (as space) occupy all the octahedral voids. What is the formula of the compound?

(a) PQ_2 (b) $P_2 Q$
 (c) PQ (d) $P_4 Q_3$

Gujarat Board-2021

Ans. (b)

5. If axial distances $a = b = c$ and axial angles 90° then crystal system is.....
 (a) Cubic (b) Rhombohedral or Trigonal
 (c) Hexagonal (d) Triclinic

Gujarat Board-2021

Ans. (b)

6. In a face centred unit cell (FCC) the number of Tetrahedral Voids.
 (a) 8 (b) 4
 (c) 6 (d) 2

Haryana Board-2022

Ans. (a)

7. An ionic crystal lattice has $\frac{r^+}{r^-}$ radius ratio of 0.32 , its co-ordination number is _____.
 (a) 3 (b) 4
 (c) 6 (d) 8

Maharashtra Board-2018

Ans. (b)

8. The number of tetrahedral voids present per atom in a cubic close packed structure is
 (a) 1 (b) 2
 (c) 3 (d) 4

Goa Board-2019

Ans. (b)

9. Which of the following lattices has the highest packing efficiency (assuming that atoms are touching each other)?
 (a) Simple cubic
 (b) Body centred cubic
 (c) Face centred cubic

Kerala Board-2020

Ans. (c)

10. In a Tetragonal unit cell:

- (a) $a = b = c$, $\alpha = \beta = \gamma \neq 90^\circ$
 (b) $a = b \neq c$, $\alpha = \beta = \gamma = 90^\circ$
 (c) $a = b = c$, $\alpha = \beta = \gamma = 90^\circ$
 (d) $a = b \neq c$, $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$

Haryana Board-2016

Ans. (b)

11. Which crystal system does CaSO_4 possess?

- (a) Triclinic (b) Hexagonal
 (c) Monoclinic (d) Tetragonal

Gujarat Board-2016

Ans.(c)

12. An element possess cubic close packing structure Calculate the radius (r) of the atom in the unit cell. (The edge length of unit cell is $a = 252 \text{ nm}$)

- (a) 152 nm (b) 89.36 nm
 (c) 126 nm (d) 109.1 nm

Gujarat Board-2018

Ans.(b) :

13. A compound is formed by two elements M and N. The element N forms CCP and atoms of M occupy $1/3^{\text{rd}}$ of tetrahedral voids. What is the formula of the compound?

- (a) M_2N_3 (b) M_3N_2
 (c) MN (d) M_4N_3

Gujarat Board-2020

Ans. (a)

14. The crystal lattice of NaCl is:

- (a) Face-centered cubic lattice
 (b) Body-centered cubic lattice
 (c) Simple cubic lattice
 (d) Hexagonal close packing

MP Board-2013

Ans. (b)

15. Which type of crystal system has axial angles $\alpha = \beta = \gamma = 90^\circ$?

- (a) cubic (b) tetrahedral
 (c) hexagonal (d) trigonal

Nagaland Board-2020

Ans. (a)

16. In which pair is the most efficient packing present?
 (i) hcp and bcc
 (ii) bcc and ccp
 (iii) hcp and ccp
 (iv) bcc and simple cubic

Meghalaya Board-2019

Ans. (c) :

17. An ionic compound has bcc structure with atoms A occupying the corners of the unit cell and B at the body centre. The formula of the ionic compound is

- (a) AB (b) AB_3
 (c) AB_2 (d) AB_4

Jharkhand Board-2023

Ans. (b)

18. In a face-centred cubic unit cell, the edge length is

- (i) $\frac{4}{\sqrt{3}}r$ (ii) $\frac{4}{\sqrt{2}}r$
 (iii) $2r$ (iv) $\frac{\sqrt{3}}{2}r$

Meghalaya Board-2018

Ans. (b)

Section-B : Very Short Answer

1. Describe the unit cell of sodium chloride with a neat diagram stating
 (i) type of bonding.
 (ii) type of unit cell.
 (iii) number of nearest neighbours around sodium and chloride.

ISC Board-2001, 2003

2. (i) Why does the presence of excess of lithium makes LiCl crystal pink?
 (ii) A solid with cubic crystal is made of two elements P and Q. Atoms of Q are at the corners of the cube and P at the body centre. What is the formula of the compound?

All India-2013

3. How many effective atoms are located at the edge centre of a unit cell in a sodium chloride crystal?

Delh-2008

4. What is meant by the term coordination number I solids?
 What is the coordination number in a face centered cubic close packing structure.

Karnataka Board-2015

5. What would be the coordination numbers of an ion occupying (a) an octahedral void and (b) a tetrahedral void?

NIOS Board-2011

6. The radius of Na^+ ion is 95 pm and that of Cl^- ion is 181 pm. Predict whether the Co-ordination number of Na^+ ion is 6 or 4.

Punjab Board-2017

7. Platinum crystallizes in a face-centered cubic lattice with all atoms at the lattice points. Calculate the mass of a unit-cell of the metallic crystal (Atomic mass of platinum = 195 amu).
Manipur Board-2022
8. Classify solids into different types on the basis of the arrangement of constituent particles.
Manipur Board-2022
9. Unit cells can be divided into two categories, Primitive and centered unit cells.
 (a) Differentiate between Unit Cell and Crystal Lattice.
 (b) Calculate the number of atoms per unit cell in the following:
 (i) Body centered cubic unit cell (bcc).
 (ii) Face centered cubic unit cell (fcc).
Kerala Board-2015
10. How many atoms can be assigned to its unit cell if an element forms.
 (i) a body centered cubic (bcc) cell.
 (ii) a face centered cubic (fcc) cell? Show by calculation.
Assam Board-2012

Section-C : Short Answer

1. An element with molar mass 27 g mol^{-1} forms a cubic unit cell with edge length 300 pm . If its density is 6.6 g cm^{-3} , identify the nature of cubic unit cell.
CBSE-2021
2. A metal crystallises in a body-centred cubic structure. If ' a ' is the edge length of its unit cell, ' r ' is the radius of the sphere, what is the relationship between ' r ' and ' a '?
Assam Board-2022
3. Classify the following solids as metallic, molecular, ionic or covalent solids:
 (a) Sodium Chloride
 (b) Silica
Draw a neat labelled diagram of a tetrahedral void observed in a crystal lattice.
Goa Board-2023
4. How is body centered cubic cell (b.c.c) formed ? Calculate the number of atoms in its unit cell.
Chhattisgarh Board-2023
5. An atom is present in a special type of void surrounded by six neighbours in a solid having cubic close-packed (ccp) structure. What types of voids are they and why are they so named?
NIOS Board-2014
6. Determine the type of cubic lattice to which the crystal of the element indicated here belongs. It has an edge length of 290 pm and a density 7.80 g cm^{-3} . Atomic mass of element = 56 amu .
Punjab Board-2017
7. A compound is formed by two elements M and N. The element N forms CCP and atoms of M occupy $\frac{1}{3}$ of tetrahedral voids. What is the formula of compound ?
Haryana Board-2021
8. What is meant by Hexagonal close packing in three dimensions?
J&K Board-2019
9. Explain the following:
 (a) Face-centered cubic
 (b) Body-centered cubic
Chhattisgarh Board-2022
10. An element has cubic close packed structure.
 (i) What is the co-ordination number of each atom?
 (ii) Give the total number of voids in $N \text{ mol}$ of it.
Kerala Board-2021
11. Write the values of axial angles for hexagonal crystal system.
Rajasthan Board-2015
12. A compound forms h.c.p. structure. Calculate the total number of voids in 0.5 mol of it.
Assam Board-2017
13. (a) For one mole close packed spheres, how many octahedral and tetrahedral voids are present?
Assam Board-2015
14. (b) Atoms of element X form hcp lattice and those of element Y form occupy $2/3$ rd of the tetrahedral voids. Determine the formula of the compound formed by the elements X and Y?
Assam Board-2015
15. If the radius of octahedral void is ' r ' and the radius of the atoms in the close packing is ' R '. What is the relation between ' r ' and ' R '?
J & K Board-2021

Section-E : Long Answer

1. (a) Calculate the packing efficiency in simple cubic crystal lattice.
 (b) Calculate the number of particles [atoms] per unit cell in Body Centred Cubic [BCC] crystal lattice.
Karnataka board 2023
2. An alloy of three metals A, B and C has the A atoms forming ccp lattice while B atoms occupy the edge centres and C atoms occupy the body centres Establish the formula of the alloy.
Manipur Board 2023
3. Find the total number of voids in 0.50 mol of a compound having hexagonal close packed structure.
Haryana Board-2016

4. a) Calculate packing efficiency of a Simple cubic lattice.
 b) An element having atomic mass 63.1 g/mol has face centred cubic unit cell with edge length $3.608 \times 10^{-8} \text{ cm}$. Calculate the density of unit cell.
 [Given: $N_A = 6.022 \times 10^{23} \text{ atoms/mol}$]
 Karnataka Board-2017
5. a) Calculate the packing efficiency in a Body Centered Cubic (BCC) lattice.
 b) Silver forms a CCP lattice. The edge length of its unit cell is 408.6 pm . Calculate the density of silver.
 $(N_A = 6.022 \times 10^{23}, \text{ Atomic mass of Ag} = 108 \text{ gmol}^{-1})$
 Karnataka Board-2016
6. a) Calculate the packing efficiency in simple cubic lattice.
 b) What is Frankel defect? Give an example.
 Karnataka Board-2014
7. a) Calculate the packing efficiency in Simple Cubic lattice.
 b) Silver crystallizes in Face-Centred Cubic (FCC) lattice. If the edge length of the cell is $4.1 \times 10^{-8} \text{ cm}$ and density is 10.4 g cm^{-3} , calculate the atomic mass (M) of Silver ($N_A = 6.022 \times 10^{23} \text{ atoms mol}^{-1}$)
 Karnataka Board-2020
8. a) Calculate the packing efficiency in Body Centered cubic (BCC) lattice.
 b) An element having atomic mass 107.9 g mol^{-1} has FCC lattice. The edge length of unit cell is 408.6 pm . Calculate the density of the unit cell.
 [Given $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$]
 Karnataka Board-2015
9. a) Calculate packing efficiency in Body centered cubic lattice.
 b) What is Schottky defect?
 Karnataka Board-2018
10. Derive packing efficiency in face centred cubic close packed structures.
 Gujarat Board-2020
11. Atoms of element B from h.c.p. lattice and those of the element A occupy $\frac{2}{3}$ rd of tetrahedral voids. Determine the formula of the compound formed by the elements A and B.
 Assam Board-2017
13. Edge length is 200 pm in body centred unit cell what will be radius of atom in pm.
 (a) 139
 (b) 150
 (c) 86.6
 (d) 93.4
 Gujarat Board-2018
14. In which of the following crystal system, all the edge length are not same?
 (a) CaCO_3
 (b) CaSO_4
 (c) ZnS
 (d) HgS
 Gujarat Board-2018
15. Formula of unit cells Density is:
 (a) $\frac{ZM}{a^3 N_A}$
 (b) $\frac{ZN_A}{a^3 M}$
 (c) $\frac{N_A a^3}{MZ}$
 (d) $\frac{Z}{MN_A}$
 MP Board-2016

Ans. (c)

14. In which of the following crystal system, all the edge length are not same?

(a) CaCO_3
 (b) CaSO_4
 (c) ZnS
 (d) HgS

Gujarat Board-2018

Ans. (b)

15. Formula of unit cells Density is:

(a) $\frac{ZM}{a^3 N_A}$
 (b) $\frac{ZN_A}{a^3 M}$
 (c) $\frac{N_A a^3}{MZ}$
 (d) $\frac{Z}{MN_A}$

MP Board-2016

Ans. (a)

Section-B : Very Short Answer

1. An element with molar mass 72 g mol^{-1} forms a cubic unit cell with edge length 400 pm . If its density is 7.5 g cm^{-3} , identify the nature of the cubic unit cell.
 CBSE-2021
2. An element X with an atomic mass of 81 u has density 10.2 g cm^{-3} . If the volume of unit cell is $2.7 \times 10^{-23} \text{ cm}^3$, identify the type of cubic unit cell.
 (Given : $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
 CBSE-2019
3. An element crystallizes in fcc lattice with a cell edge of 300 pm . The density of the element is 10.8 g cm^{-3} . Calculate the number of atoms in 108 g of the element.
 CBSE-2019
4. (a) Atoms of element B form hcp lattice and those of the element A occupy $\frac{2}{3}$ rd of octahedral voids. What is the formula of the compound formed by the elements A and B?
 (b) What type of stoichiometric defect is shown by ZnS and why?
 CBSE-2019
5. An element crystallizes in a fcc lattice with cell edge of 250 pm . Calculate the density if 300 g of this element contains 2×10^{24} atoms.
 CBSE-2019
6. Aluminium crystallises in a fcc structure. Atomic radius of the metal is 125 pm . What is the length of the side of unit cell of the metal ?
 CBSE-2019
7. The compound CuCl has fcc structure like ZnS . Its density is 3.04 g cm^{-3} . What is the volume of unit cell ?
 Given : Atomic mass of Cu = 63.5 u ; Cl = 35.5 u
 $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
 CBSE-2019

G. Calculation Involving Unit Cell

Section-A : Multiple Choice Questions

12. A compound is formed by two elements M and N. The element N forms CCP and atoms of M occupy $1/3$ rd of tetrahedral voids. What is the formula of the compound?
 (a) M_3N_2
 (b) MN
 (c) M_3N
 (d) M_2N_3
 Gujarat Board-2022 (July)

Ans. (d)

8. An element crystallizes in a bcc lattice with cell edge of 400 pm. Calculate the density of 250 g of this element contains 2.5×10^{24} atoms
CBSE-2019
9. An element crystallizes in a FCC lattice with cell edge of 400 pm. The density of the element is 7 g cm^{-3} . How many atoms are present in 280 of the element?
CBSE-2019
10. What is the formula of a compound in which the element 'Y' forms hcp lattice and atoms of 'X' occupy 1/3rd of octahedral voids ?
CBSE-2019
11. Write the formula of the compound in which element 'Y' forms hcp lattice and atoms of 'X' occupy 2/3rd of tetrahedral voids.
CBSE-2019
12. What is the coordination number of atoms in a (i) bcc structure, and (ii) fcc structure ?
CBSE-2019
13. Chromium crystallises in bcc structure. If its edge length is 300 pm, find its density. Atomic mass of chromium is 52 u. [$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$]
CBSE-2019
14. A compound AB has a cubic structure and molecular mass 99. Its density is 3.4 g/cm^3 . What is the length of the edge of the unit cell?
ISC Board-2011
15. The edge length of unit cell of a body centred cubic (bcc) crystal is 352 pm. Calculate the radius of the atom.
ISC Board-2016
16. Lead (II) sulphide has fcc crystal structure. The edge length of the unit cell of PbS crystal is 500 pm. What is its density? ($\text{Pb} = 207.2, \text{S} = 32$).
ISC Board-2010
17. A bcc element (atomic mass 65) has a cell edge of 420 pm. Calculate its density in g/cm^3 .
ISC Board-2013
18. A compound AB has a simple cubic structure and has molecular mass 99. Its density is 3.4 g cm^{-3} . What will be the edge length of the unit cell?
ISC Board-2016
19. Chromium metal crystallises with a body centred cubic lattice. The edge length of the unit cell is found to be 287 pm. Calculate the atomic radius. What would be the density of chromium in g/cm^3 ? (Atomic mass of Cr = 52.99)
ISC Board-2015
20. Lead sulphide has face centered cubic crystal structure. If the edge length of the unit cell of lead sulphide is 495 pm, calculate the density of the crystal. (at. wt. Pb = 207, S = 32)
ISC Board-2017
21. An ionic compound is made up of A cations and B anions. If A cations are present at the alternate corners and B anion is present on the body of the diagonal, what is the formula of the ionic compound?
ISC Board-2014
22. Which point defect in crystals of a solid decreases the density of the solid?
Delh-2010; All India-2009 Foreign-2009
23. What is the percentage efficiency of packing in case of a simple cubic lattice?
All India-2009C
24. An element with density 2.8 g cm^{-3} forms a fcc unit cell with edge length $4 \times 10^{-8} \text{ cm}$. Calculate the molar mass of the element. (Given, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$).
Delh-2014
25. The density of copper is 8.95 g cm^{-3} . It has a face centered cubic structure. What is the radius of copper atom? (Atomic mass of Cu = 63.5 g mol^{-1} , $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$).
Delh-2014C
26. An element with density 11.2 g cm^{-3} forms a fcc lattice with edge length of $4 \times 10^{-8} \text{ cm}$. Calculate the atomic mass of the element. (Given, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$).
All India-2014
27. Iron has a body centered cubic unit cell with a cell dimension of 286.65 pm. The density of iron is 7.874 g cm^{-3} , use this information to calculate Avogadro's number. (Gram atomic mass of Fe = 55.84 g mol^{-1}).
Foreign-2014
28. Iron has a body centred cubic unit cell with a cell edge of 286.65 pm. The density of iron is 7.874 g cm^{-3} . Use this information to calculate Avogadro's number. (Atomic mass of iron = 56 g mol^{-1}).
All India-2012,2009; Delh-2012, 2009; Foreign-2010 2010,2009
29. Explain how can you determine the atomic mass of an unknown metal if you know its mass, density and the dimensions and type of unit cell of its crystal?
All India-2011
30. Calculate the packing efficiency of a metal crystal for a simple cubic lattice.
All India-2011; Delh-2011C
31. Silver crystallizes in face centred cubic unit cell. Each side of the unit cell has a length of 409 pm. What is the radius of silver atom?
Foreign-2011, 2009; All India-2010,2009
32. Copper crystallises into fcc Lattice with edge length $3.61 \times 10^{-8} \text{ cm}$. Calculate the density of copper. (Atomic mass of Cu = 63.5 g mol^{-1} , $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$).
Delh-2010, 2009C

33. Chromium metal crystallizes in a body centred cubic lattice. The length of the unit cell edge is found to be 287 pm. Calculate the atomic radius of chromium.
- Delhi-2010C
34. The edge of the face centred cubic unit cell of aluminium is 404 pm. Calculate the radius of aluminium atom.
- Delhi-2010C
35. An element crystallizes in a bcc lattice with cell edge of 500 pm. The density of the element is 7.5 g cm^{-3} . How many atoms are present in 300 g of the element?
- All India-2016
36. An alloy of gold and cadmium crystallizes with a cubic structure in which gold atoms occupy the corners and cadmium atoms fit into the face centres. Assign formula for this alloy.
- All India-2011C
37. (i) In reference to crystal structure, explain the meaning of the coordination number.
(ii) What is the number of atoms in a unit cell of
(a) a face centred cubic structure?
(b) a body centred cubic structure?
- Delhi-2009C
38. What is the formula of a compound in which the element Y forms ccp lattice and atoms of X occupy $\frac{2}{3}$ rd of octahedral voids?
- All India-2015; Foreign-2015
39. What is the formula of a compound in which the element y forms ccp lattice and atoms of X occupy $\frac{1}{3}$ rd of tetrahedral voids?
- Delhi- 2015
40. An element 'X' (At. mass = 40 g mol^{-1}) having f.c.c. structure, has unit cell edge length of 400 pm. Calculate the density of 'X' and the number of unit cells in 4 g of 'X'. ($N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
- UP Board-2018
41. Analysis shows that FeO has a non-stoichiometric composition with formula $\text{Fe}_{0.95}\text{O}$. Give reason.
- UP Board-2018
42. If the radius of octahedral void is r and radius of the atom in close packing is R . Write the relation between r and R .
- Manipur Board-2018
43. Lithium metal has a body centred cubic lattice structure with edge length of edge unit cell 352 pm. Calculate the density of lithium metal. [Given: Atomic mass of Li = 7 g mol^{-1} , $N_A = 6.022 \times 10^{23} \text{ Atoms mol}^{-1}$]
- Karnataka Board-2019
44. (a) An element having bcc geometry has atomic mass 60 g mol^{-1} . Calculate the density of Unit cell, if its edge length is 300 pm.
- (b) Give two differences between Crystalline solids and Amorphous solids.
- Punjab Board-2019
45. (a) An element with density 11.2 g cm^{-3} forms fcc lattice with edge length of $4 \times 10^{-8} \text{ cm}$. Calculate the atomic mass of the substance
(b) Define Unit cell and Paramagnetic substance.
- Punjab Board-2019
46. A compound of X and Y crystallizes in the cubic structure in which Y atoms are at the corners and X atoms are at the alternate faces of the cube. Find the formula of the compound.
- Punjab Board-2019
47. Elements A and B form a crystalline compound. In the crystal, atoms of element A form cubic closed packed structure and atoms of element B occupy $\frac{1}{3}$ rd of tetrahedral voids. Calculate the formula of the compound.
- Manipur Board-2019
48. How much part of an atom of the primitive cubic unit cell actually belongs to a particular unit cell?
- Rajasthan Board-2016
49. A compound forms hexagonal close packed (hcp) structure. What is the total number of voids in 0.5 mol if it? How many of these are tetrahedral void?
- Assam Board-2012
50. An element having a face-centred cubic unit cell has a molar mass 60 g mol^{-1} and a cell edge of 400 pm. What is its density? [$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$].
- Nagaland Board-2017

Section-C : Short Answer

1. An element crystallises in Face Centred Crystal [FCC] lattice. The edge length of the unit cell is 556 pm and it has density 1.55 g cm^{-3} . Calculate the atomic mass of the element. [Given : $N_A = 6.022 \times 10^{23}$]
- Karnataka board 2023
2. Calculate number of particles in face centered cubic unit cell.
- Rajasthan Board 2023
3. An element crystallizes in fcc lattice with a cell edge of 300 pm. The density of the element is 10.8 g cm^{-3} . Calculate the number of atoms in 108 g of the element.
- CBSE-2019
4. (a) An element crystallises in bcc lattice with a cell edge of $3 \times 10^{-8} \text{ cm}$. The density of the element is 6.89 g cm^{-3} . Calculate the molar mass of the element. ($N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
(b) What type of semiconductor is obtained when
(i) Ge is doped with In ?
(ii) Si is doped with P ?
- CBSE-2019

5. An element crystallizes in a fcc lattice with cell edge of 250 pm. Calculate the density if 300 g of this element contain 2×10^{24} atoms.
- Delhi-2016
6. An element with molar mass 27 g mol^{-1} forms a cubic unit cell with edge length $4.05 \times 10^{-8} \text{ cm}$. If its density is 2.7 g cm^{-3} , what is the nature of the cubic unit cell?
- Delhi-2015
7. An element X (molar mass = 60 g mol^{-1}) has a density of 6.23 g cm^{-3} . Identify the type of cubic unit cell, if the edge length of the unit cell is $4 \times 10^{-8} \text{ cm}$.
- Foreign-2015
8. Silver crystallizes in fcc lattice. If edge length of the unit cell is $4.077 \times 10^{-8} \text{ cm}$, then calculate the radius of silver atom.
- All India-2015C
9. Niobium crystallizes in body centered cubic structure. If its density is 8.55 g cm^{-3} , calculate the atomic radius of niobium, given its atomic mass is 934.
- Delhi-2013C
10. An element occurs in bcc structure. It has a cell edge length of 250 pm. Calculate the molar mass if its density is 8.0 g cm^{-3} . Also, calculate the radius of an atom of this element.
- Delhi-2013C
11. Silver crystallizes in face centred cubic (fcc) unit cell. If the radius of silver atom is 145 pm, what is the length of each side of the unit cell?
- Foreign-2012
12. Tungsten crystallizes in body centred cubic unit cell. If the edge of the unit cell is 316.5 pm, what is the radius of tungsten atom?
- Delhi-2012
13. Copper crystallizes with face centred cubic unit cell. If the radius of copper atom is 127.8 pm, calculate the density of copper metal. (Atomic mass of Cu = 63.55 u, $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$).
- All India-2012
14. An element X crystallizes in fcc structure. 208 g of it has 4.2832×10^{24} atoms. calculate the edge of unit cell if density of X is 7.2 g cm^{-3} .
- Delhi-2012C
15. The density of lead is 11.35 g cm^{-3} and the metal crystallises with fcc unit cell. Estimate the radius of lead atom (Atomic mass of lead = 207 g mol $^{-1}$ and $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$).
- Delhi-2011
16. Aluminium crystallizes in a cubic close packed structure. Radius of the atom in the metal is 125 pm.
- (i) What is the length of the side of the unit cell?
- (ii) How many unit cells are there in 1 cm^3 of aluminium?
- Foreign-2011
17. Silver crystallizes in face centred cubic unit cell. Each side of this unit cell has a length of 400 pm. Calculate the radius of the silver atom (Assume, the atoms just touch each other on the diagonal across the face of the unit cell. That is each face atom is touching the four corner atoms).
- Delhi-2011
18. The well known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral, there are 4Ca^{2+} ions and 8F^- ions and that Ca^{2+} ions are arranged in a fcc lattice. The F^- ions fill all tetrahedral holes in the face centred cubic lattice of Ca^{2+} ions. The edge of the unit cell is $5.46 \times 10^{-8} \text{ cm}$ in length. The density of the solid is 3.18 g cm^{-3} . Use this information to calculate Avogadro's number
(Molar mass of $\text{CaF}_2 = 78.08 \text{ g mol}^{-1}$).
- Delhi-2010
Foreign-2010
19. The density of copper metal is 8.95 g cm^{-3} . If the radius of copper atom is 127.8 pm, is the copper unit cell a simple cubic, a body centred cubic or face centred cubic structure? (Atomic mass of Cu = 63.54 g mol^{-1} and $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$).
- Delhi-2010; All India-2010
20. Copper crystallizes in face centred cubic lattice and has density of 8.930 g cm^{-3} at 293 K. Calculate the radius of copper atom. (Atomic mass of Cu = 63.55 u , $N_A = 6.02 \times 10^{23}$).
- All India-2010C
21. Silver crystallizes in fcc lattice. If the edge length of the unit cell is $4.07 \times 10^{-8} \text{ cm}$ and the density of the crystal is 10.5 g cm^{-3} , calculate the atomic mass of silver. ($N_A = 6.02 \times 10^{23} \text{ atom mol}^{-1}$).
- All India-2008, 2010
Foreign-2008
22. Silver crystallises in fcc lattice. If the edge length of the cell is $4.077 \times 10^{-8} \text{ cm}$. and density is 10.5 gm cm^{-3} then calculate the atomic mass of silver.
- Uttarakhand Board-2020
- 23.(i) NaCl has fcc structure Calculate the number of NaCl units in a unit cell of NaCl.
(ii) Calculate the density of NaCl, if edge length of NaCl unit cell is 564 pm. [Molar mass of NaCl = 58.5 g/mol].
- Kerala Board-2013
24. What is the ratio of octahedral holes to the number of anions in hexagonal closed packed structure ?
- Maharashtra Board-2019
25. An element crystallises as FCC with density 2.8 g cm^{-3} . Its unit cell having edge length $4 \times 10^{-8} \text{ cm}$. Calculate the molar mass of the element . (Given $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)
- Kerala Board-2018

- | | |
|--|--|
| <p>26. Lead sulphide has face centered cubic crystal structure. If the edge length of the unit cell of lead sulphide is 495 pm, calculate the density of the crystal, (at. wt, Pb = 207, S = 32)</p> <p style="text-align: right;">ISC Board-2017</p> | <p>(ii) Write any two differences between amorphous solids and crystalline solids.</p> |
| <p>27. Silver metal crystallises with a face centred cubic lattice. The length of the core of unit cell is found to be 4.077×10^{-8} cm. Calculate the atomic radius and density of silver.</p> <p style="text-align: right;">Jharkhand Board-2020</p> | <p>Silver crystallizes in fcc structure. If edge length of unit cell is 400 pm, calculate density of silver (Atomic mass of Ag = 108).
Write a note on Haloform reaction.</p> |
| <p>28. What is the formula of a compound in which the element Y forms cubic closed packed (ccp) lattice and atoms of X occupy 1/3rd of tetrahedral voids?</p> <p style="text-align: right;">Assam Board-2019</p> | <p>X-ray diffraction studies show that copper crystallizes in a fee lattice with edge length of 3.608×10^{-8} cm. If density of copper is 8.92 g cm^{-3}, calculate the atomic mass of copper.</p> |
| <p>29. If the radius of the octahedral void is 'r' and radius of the atoms in closed packing is 'R', derive relation between 'r' and 'R'.</p> <p style="text-align: right;">Nagaland Board-2020</p> | <p>Assam Board-2014</p> <p>Calculate the value of Avogadro number (N_A) from following data:</p> <ul style="list-style-type: none"> (a) Density of NaCl = 2.165 gm cm^{-3} (b) Distance between Na^+ & Cl^- in NaCl = 281 pm. |
| <p>30. An element has bcc structure with cell edge of 288 pm. The density of the element is 7.2 g cm^{-3}. How many atoms are present in 208 g of the element?</p> <p style="text-align: right;">Meghalaya Board-2019</p> | <p>Haryana Board-2017</p> <p>Calculate atomic radius of elementary silver which crystallises in face-centered cubic lattice with unit cell edge length 4.086×10^{-10} m.</p> |
| <p>31. Silver forms c.c.p. lattice and X-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Calculate the density of silver. (Atomic mass = 107.9 u)</p> <p style="text-align: right;">Meghalaya Board-2021</p> | <p>Assam Board-2016</p> <p>Aluminium crystallises as face-centered cubic lattice and it has a density of $2.7 \times 10^3 \text{ kgm}^{-3}$. Calculate edge length of the unit cell. Given atomic mass of aluminium equal to 27.0 amu.</p> |
| <p>32. The edge length of a face centered cubic cell of an ionic substance is 508 pm. If the radius of the cation is 110 pm, then calculate the radius of the anion.</p> <p style="text-align: right;">Assam Board-2023</p> | <p>Assam Board-2016</p> <p>Copper crystallises into a fcc lattice. Its edge length is 3.61×10^{-8} cm. Calculate the density of copper (at mass of copper = 63.5u ; $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)</p> |
| <p>33. Silver forms ccp lattice and X-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Claculate the density of silver. (Atomic mass = 107.9u).</p> <p style="text-align: right;">Nagaland Board-2021</p> | <p>Assam Board-2012</p> |
| <p>34. Calculate the value of Avogadro's number from the data : density of NaCl = 2.165 g cm^{-3}, distance between Na^+ and Cl^- in NaCl crystal is 281 pm (molar mass of NaCl is 58.5 g mol^{-1}).</p> <p style="text-align: right;">Nagaland Board-2018</p> | <p>H. Imperfections in Solids</p> <p>Section-A : Multiple Choice Questions</p> <p>1. The incorrect statement about interstitial compounds is</p> <ul style="list-style-type: none"> (a) They are chemically reactive. (b) They are very hard. (c) They retain metallic conductivity. (d) They have high melting point. |

Section-D : Case Based Study

1. (a) An element having atomic mass 80 g adopts face centre cubic structure. Calculate the number of unit cells present in 8 g of the element.

(b) NaCl crystal becomes yellowish when heated with sodium vapour. Explain what effect would be observed on the density of the crystal?

Manipur Board 2023

Section-E : Long Answer

1. (i) An element has atomic mass 93 g mol^{-1} and density 11.5 g cm^{-3} . If the edge length of its unit cell is 300 pm , identify the type of unit cell.

CBSE-2021

Ans. (b)

Page 10 of 10

7

4. The stoichiometric defect that decreases the density of an ionic solid is
 (a) Frenkel defect (b) Interstitial defect
 (c) Metal excess defect (d) Schottky defect

Goa Board-2023, 2019

Ans. (d)

5. Which of the following has Frenkel defects?

- (a) AgBr (b) NaCl
 (c) Graphite (d) Diamond

Haryana Board -2016

Ans. (a)

6. Due to which defect the density of crystal decreases?

- (a) F-centre (b) Schottky
 (c) Interstitial (d) Frenkel

Gujarat Board-2016

Ans. (b)

7. In which of the following defect some of the cations are arranged in the interstitial site?

- (a) Schottky defect (b) Metal excess defect
 (c) Frenkel defect (d) Interstitial defect

Gujarat Board-2019

Ans. (c)

8. When cation of higher oxidation state is added in ionic solid substance, then which type of defect is formed in it?

- (a) Schottky defect (b) Impurity defect
 (c) Frenkel defect (d) Metal Excess defect

Gujarat Board-2020

Ans: (b)

9. Which defects does not affect density of the crystal?

- (a) Schottky defects (b) Interstitial defects
 (c) Frenkel defects (d) None of the above

Haryana Board-2016

Ans. (c)

10. The defect in which the crystal lattice have the vacancy of one cation and one anion is:

- (a) Ionic defect
 (b) Atomic defect
 (c) Frankel defect
 (d) Schottky defect

MP Board-2018

Ans. (d)

11. For Increasing of electro-conductivity in a solid crystal, mixing of impurities is known as:

- (a) Schottky defect (b) Frenkel defect
 (c) Doping (d) Electronic-Defect

MP Board-2016

Ans. (a)

12. Which kind of point defect is found in KCl crystal?

- (a) Frenkel (b) Schottky
 (c) Linear (d) Impurity

MP Board-2013

Ans. (b)

13. The correct example of "Frenkel Defect" is:
 (a) NaCl (b) CsCl
 (c) KCl (d) AgCl

MP Board-2012

Ans. (d)

14. The appearance of colour in solid alkali metal halides is generally due to

- (a) Schottky defect (b) Frenkel defect
 (c) Interstitial defect (d) F-centres

Meghalaya Board-2021

Nagaland Board-2021

Ans. (d)

15. The presence of F-centres in a crystal makes it

- (a) conducting (b) non-conducting
 (c) coloured (d) colourless

Nagaland Board-2017

Ans. (c)

Section-B : Very Short Answer

1. (a) What type of stoichiometric defect is shown by NaCl and why ?
 (b) Calculate the efficiency of packing in case of a metal crystal for face centred cubic unit cell.

CBSE-2019

2. Write two differences between Frankel and Schottky defect.

Gujarat Borad-2022 (July)

3. KBr crystal does not show Frenkel defect. Give reason

Manipur Board 2020

4. The chemical formula of ionic solid showing Frenkel and Schottky both types of point defect is _____.

Rajasthan Board 2022

5. What is Schottky defect ? What is the effect of the presence of Schottky defect on the density of lattice ?

UP Board 2023

6. Differentiate between Schottky defect and Frenkel defect.

Uttarakhand Board 2023

7. Out of KCl and AgCl, which one shows Schottky defect and why?

CBSE-2019

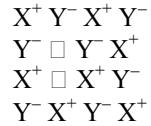
8. What type of stoichiometric defect is shown by ZnS and why ?

CBSE-2019

9. Out of NaCl and AgCl, which one shows Frenkel defect and why ?

CBSE-2019

10. Name the defect in the following crystal :



CBSE-2019

11. What type of defect is shown by NaCl in
 (a) stoichiometric defects, and
 (b) non-stoichiometric defects ?
- CBSE-2019
12. Define Frenkel defect in solid crystal.
- ISC Board-2014
13. What is Schottky defect in a solid?
- ISC Board-2013
14. Define piezoelectricity and give one use of piezoelectric crystals.
- ISC Board-2011
15. Frenkel defect does not change the density of the ionic crystal whereas, Schottky defect lowers the density of ionic crystal. Give a reason.
- ISC Board-2017
16. (i) What are F-centres in an ionic crystal?
 (ii) Why are crystals having F-centres paramagnetic?
- ISC Board-2012
17. Account for the following.
 (i) Schottky defects lower the density of related solids.
 (ii) Conductivity of silicon increases on doping it with phosphorus.
- All India-2013
18. What are F-centres?
- All India-2008C
19. (i) Write the type of magnetism observed when the magnetic moments are oppositely aligned and cancel out each other.
 (ii) Which stoichiometric defect does not change the density of the crystal?
- Delhi-2014 or All India-2014 (ii)
20. Examine the given defective crystal.
- | | | | | |
|-------|-------|-------|-------|-------|
| A^+ | B^- | A^+ | B^- | A^+ |
| B^- | | B^- | A^+ | B^- |
| A^+ | B^- | A^+ | | A^+ |
| B^- | A^+ | B^- | A^+ | B^- |
- Answer the following questions.
- (i) What type of stoichiometric defect is shown by the crystal?
 (ii) How is the density of the crystal affected by this defect?
 (iii) What type of ionic substances show such defect?
- All India-2014; Delhi-2014
21. (i) What type of non-stoichiometric point defect is responsible for the pink colour of LiCl?
 (ii) What type of stoichiometric defect is shown by NaCl?
- Delhi-2014
22. (i) What type of stoichiometric defect is shown by KCl and why?
 (ii) What type of semiconductor is formed when silicon is doped with As?
- Haryana Board-2019
23. (iii) Which one of the following is an example of molecular solid?
 CO_2 or SiO_2
- (iv) What type of substance would make better magnets, ferromagnetic or ferrimagnetic?
- Foreign-2014
24. Give an example of an ionic compound which shows Frenkel defect.
- All India-2010C
25. Why is Frenkel defect not found in pure alkali metal halides?
- All India-2010C
26. Which point defect in its crystal units alters the density of a solid?
- Delhi-2009
27. Which point defect in crystals of a solid does not change the density of the solid?
- Delhi-2010, 2009
28. What type of stoichiometric defect is shown by $AgBr$ and AgI ?
- All India-2012
29. What type of defect can arise when a solid is heated?
- All India-2012C
30. What type of stoichiometric defect is shown by $NaCl$?
- Delhi-2014C
31. What type of stoichiometric defect is shown by $AgCl$?
- All India-2015C; Delhi-2013
32. Explain metal excess defect.
- Gujarat Board-2016
33. Why is Frenkel defect not shown by alkali metal halides? Name the ionic compound which can show this type of defect.
- Manipur Board-2018
34. What is Schottky defect?
- Manipur Board-2017
35. What is Frenkel defect? How does it affect density of the solid?
- Karnataka Board-2018
36. What types of stoichiometric defects are shown by $CsCl$ and $AgBr$?
- NIOS Board-2015
37. Explain Schottky defect with a suitable example.
- NIOS Board-2012
- An oxide of chromium is found to have the following composition Cr = 68.4% and O = 31.6%. Determine the empirical formula of the compound.
 [Atomic mass : Cr = 52 g mol⁻¹; O = 16.0 g mol⁻¹]
- NIOS Board-2023
38. Write short note on Frenkel defect.
- Gujarat Board-2019
39. What type of stoichiometric defect is shown by ZnS ?

		Section-C : Short Answer																								
40.	What is Schottky defect ?	Haryana Board-2021																								
41.	Draw neat labelled diagram of the stoichiometric defect observed in ionic solids having ions of similar size. What is the effect of this defect on the density of the crystal?	Goa Board-2018																								
42.	Which type of Stoichiometric defect is shown by the following solids?	Karnataka Board-2016																								
43.	Write the consequences of Schottky defect with reasons.	Maharashtra Board-2022																								
44.	Explain the following terms :	Maharashtra Board-2023																								
	(i) Substitutional impurity defect																									
	(ii) Interstitial impurity defect																									
45.	Write an ionic compound which can exhibit both Schottky and Frenkel defect.	Kerala Board-2022																								
46.	What is meant by imperfections in solids ? What is the effect of interstitial defect on the density of a solid ?	Manipur Board-2019																								
47.	A compound formed by elements A and B has the A atoms forming a ccp lattice and the B atoms occupy half of the tetrahedral voids. What is the co-ordination number of B atoms in the crystal ?	Manipur Board-2022																								
48.	Derive Bragg's equation.	Andhra Pradesh Board-2016																								
49.	Presence of excess Sodium makes NaCl crystal coloured. Explain on the basis of crystal defects.	Kerala Board-2016																								
50.	What is Schottky defect?	Andhra Pradesh Board-2021																								
51.	Derive Bragg's equation .	Andhra Pradesh Board-2021																								
52.	Dislocation of which ion in "Ag Br" develops Frenkel defect?	Rajasthan Board-2016																								
53.	When does Frenkel defect arise? Give reason.	Rajasthan Board-2011																								
54.	What is metal deficiency defect? Given an example.	Tamilnadu Board, Sep.-2016																								
55.	Which point defect lowers the density of a crystal?	Assam Board-2015, 2013																								
56.	F-centers give colour to crystal due to whose presence?	MP Board-2018																								
57.	Due to Schottky defect, density of a crystal																									
58.	Explain Schottky defect.	J & K board-2023																								
59.	Why is Frenkel defect not found in pure alkali metal halides ?	Meghalaya Board-2018																								
1.		A metal crystallizes in face centered cubic unit cell with $a = 0.560 \text{ nm}$. Calculate the density of the metal if it contains 0.1% Schottky defects. Given: atomic mass of metal = 40 g mol^{-1}																								
2.		All India-2008C																								
Match the pairs :																										
<table border="1" style="width: 100%;"><thead><tr><th colspan="2" style="text-align: center;">"A"</th><th colspan="2" style="text-align: center;">"B"</th></tr></thead><tbody><tr><td>(A)</td><td>Schottky defect</td><td>(i)</td><td>ZnS</td></tr><tr><td>(B)</td><td>Frankel defect</td><td>(ii)</td><td>NaCl</td></tr><tr><td>(C)</td><td>Paramagnetism</td><td>(iii)</td><td>O_2</td></tr><tr><td>(D)</td><td>Zinc blende</td><td>(iv)</td><td>Cu_2O</td></tr><tr><td>(E)</td><td>Cuprite</td><td>(v)</td><td>AgCl</td></tr></tbody></table>		"A"		"B"		(A)	Schottky defect	(i)	ZnS	(B)	Frankel defect	(ii)	NaCl	(C)	Paramagnetism	(iii)	O_2	(D)	Zinc blende	(iv)	Cu_2O	(E)	Cuprite	(v)	AgCl	
"A"		"B"																								
(A)	Schottky defect	(i)	ZnS																							
(B)	Frankel defect	(ii)	NaCl																							
(C)	Paramagnetism	(iii)	O_2																							
(D)	Zinc blende	(iv)	Cu_2O																							
(E)	Cuprite	(v)	AgCl																							
		MP Board 2020																								
3.	Germanium is an intrinsic semiconductor. How can you increase its conductivity?	Manipur Board 2023																								
4.	Explain P-type semiconductor by one example.	Rajasthan Board 2023																								
5.	Explain the following giving a suitable example in each case.																									
	(i) Frenkel defect																									
	(ii) F-centres																									
	(iii) Paramagnetism																									
6.	Explain the following terms with suitable examples.	Foreign-2008																								
	(i) Schottky defect																									
	(ii) Ferromagnetism																									
		Delh-2008C																								
7.	Account for the following:																									
	(i) Fe_3O_4 is ferromagnetic at room temperature but becomes paramagnetic at 850 K.																									
	(ii) Zinc oxide on heating becomes yellow.																									
	(iii) Frenkel defect does not change the density of AgCl crystals.																									
8.	How would you account for the following?	All India-2008C																								
	(i) Frenkel defects are not found in alkali metal halides.																									
	(ii) Schottky defects lower the density of related solids.																									
	(iii) Impurity doped silicon is semiconductor.																									
		Delh-2008																								
9.	Examine the given defective crystal:																									
	X^+ Y^- X^+ Y^- X^+ Y^- O Y^- X^+ Y^- X^+ Y^- X^+ O X^+ Y^- X^+ Y^- X^+ Y^-																									
Answer the following questions:																										
	(i) Is the above defect stoichiometric or non-stoichiometric?																									
	(ii) Write the term used for this type of defect. Give an example of the compound which shows this type of defect.																									
	(iii) How does this defect affect the density of the crystal?																									
		All India-2015																								

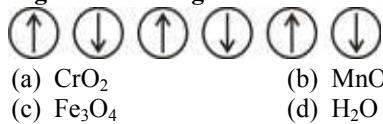
- | | | | | | |
|-----|---|---|-----|---|----------------------|
| 10. | Define the following:
(i) Schottky defect
(ii) Frenkel defect
(iii) F-centres | Delhi-2015 | 23. | Define the following terms:
(a) F-Centre | Haryana Board-2018 |
| 11. | How are the following properties of crystals affected by Schottky and Frenkel defects?
(i) Density
(ii) Electrical conductivity | Delhi-2010, 2009C | 24. | Write any two differences between Schottky and Frenkel defects. | Rajasthan Board-2019 |
| 12. | Explain Schottky and Frenkel defects. | Telangana Board-2023 | 25. | On the basis of nature of ionic solids compare Frenkel defect with Schottky defect. | Rajasthan Board-2014 |
| 13. | What are stoichiometric and non-stoichiometric defects? Name the stoichiometric defect found in ionic compounds which does not change the density. How does it arise? What type of ionic compounds shows this defect? | Tamil Nadu Board-2015 | 26. | Give the names of defects found in AgBr crystal. Explain these defects with reason. | Rajasthan Board-2010 |
| 14. | (i) Which type of stoichiometric defects is shown by AgBr crystal ?
(ii) Chromium (atomic mass = 52) metal has body centred cubic structure. The radius of chromium atom is 124.3 pm. Calculate the density of chromium metal. | NIOS Board-2015
West Bengal Board-2019 | 27. | Explain Frenkel defect. | Gujarat Board-2017 |
| 15. | Define the following with suitable examples :
(a) F-centres
(b) Antiferromagnetism | Haryana Board-2019 | 28. | Describe Schottky defect in crystals. | J&K Board-2020 |
| 16. | Explain the following :
(a) Schottky defect
(b) Frenkel defect | Chhattisgarh Board-2022 | 29. | Differentiate between Schottky and Frenkel defect. | Jharkhand Board-2023 |
| 17. | What are point defects? Explain the non-stoichiometric point defects in ionic crystals. | Kerala Board-2019 | | | |
| 18. | Draw a neat labelled diagram to show Frenkel defect and write any one condition for an ionic solid to show this defect. | Goa Board-2019 | | | |
| 19. | Frenkel defect does not change the density of the ionic crystal whereas, Schottky defect lowers the density of ionic crystal. Give a reason. | ISC Board-2017 | | | |
| 20. | Schottky defect and Frenkel defect are two types of stoichiometric point defects shown by ionic solids. Give two points of difference between Schottky defect and Frenkel defect. | Kerala Board-2020 | | | |
| 21. | Explain the following.
(a) Frenkel defect.
(b) Ferromagnetism. | Assam Board-2014 | I. | Electrical and Magnetic Properties | |
| 22. | Explain the following terms with examples :
(i) Metal excess defects
(ii) Metal deficiency defects | Haryana Board -2016 | | Section-A : Multiple Choice Questions | |

I. Electrical and Magnetic Properties

Section-A : Multiple Choice Questions

Ans. (c)

2. Which compound has following schematic alignment of magnetic moments?



Gujarat Board-2022 (July)

Ans. (c)

3. Which one of the following has the highest dipole moment?



Haryana Board 2023

Ans. (b)

4. A ferromagnetic substance becomes a permanent magnet when it is placed in a magnetic field because _____

- (a) All the domains get oriented in the direction of magnetic field.
 (b) All the domains get oriented in the direction opposite to the direction of magnetic field.
 (c) Domains get oriented randomly.
 (d) Domains are not affected by magnetic field.

Manipur Board-2017

Ans. (a)

5. The crystals which are good conductors of heat and electricity are:

- (a) Ionic crystals (b) Molecular crystals
 (c) Metallic crystals (d) Covalent crystals

Tamil Nadu Board-2016

Ans. (c)

6. Which of the following will be paramagnetic

- (a) Cr^{3+} (b) Na^+
 (c) O_2^- (d) Cu^+

Gujarat Board-2019

Ans. (a)

7. Which of the following substance is ferromagnetic?

- (a) CuCl_2 (b) CrO_2
 (c) NaCl (d) MnO

Gujarat Board-2016

Ans. (b)

8. Which of the following substance is antiferromagnetic?

- (a) MnO (b) CrO_2
 (c) Fe_3O_4 (d) NaCl

Gujarat Board-2017

Ans. (a)

9. Which compound becomes paramagnetic on heating?

- (a) C_6H_6 (b) MnO
 (c) Fe_3O_4 (d) NaCl

Gujarat Board-2018

Ans. (c)

10. From the following which type of magnetic substance magnetite is known?

- (a) Diamagnetic (b) Ferromagnetic
 (c) Antiferromagnetic (d) Ferrimagnetic

Gujarat Board-2019

Ans. (d)

11. Which of the following is ferromagnetic?

- (a) Calcium metal (b) Iron metal
 (c) Sodium metal (d) Zinc metal

MP Board-2013

Ans. (b)

12. Silicon is:

- (a) Good conductor (b) Bad conductor
 (c) Semiconductor (d) Ore

MP Board-2013

Ans. (c)

13. To get p-type semiconductor, impurity to be added to silicon should have which of the following numbers of valence electrons?

- (i) 2 (ii) 3
 (iii) 1 (iv) 5

Meghalaya Board-2018

Ans. (b)

Section-B : Very Short Answer

1. Compare paramagnetism and diamagnetism.

Rajasthan Board 2022

2. Why conductivity of silicon increases on doping with phosphorus?

CBSE-2019

3. What would be the nature of solid if there is no energy gap between Valence band and Conduction band?

CBSE-2019

4. What are semiconductors? What is the effect of increasing temperature on the conductivity of a semiconductor?

ISC Board-2011

5. Diamond is hard and a bad conductor of electricity while graphite is soft and a good conductor of electricity. Explain, state the hybridisation of carbon in both substances.

ISC Board-2002

6. Explain by giving reasons why ionic solids conduct electricity in molten state but not in solid state.

ISC Board-2014

7. Explain the following terms with one suitable example of each.

- (i) Ferromagnetism
 (ii) Paramagnetism

Delh-2010C

8. Describe the two main types of semiconductors and contrast their conduction mechanism.

All India-2009C

9. (i) What change occurs when AgCl is doped with CdCl_2 ?
(ii) What type of semiconductor is produced when silicon is doped with boron?
- All India-2013
10. If NaCl is doped with 10^{-3} mole per cent SrCl_2 , What will be the concentration of cation vacancies?
 $(N_A = 6.02 \times 10^{23} \text{ mol}^{-1})$
- All India-2013C
11. Explain the following terms with suitable example of each.
(i) Ferromagnetism
(ii) Anti-ferromagnetism
- Delhi-2011C
12. In terms of band theory, explain the difference between a conductor and a semiconductor and give one suitable example for each.
- All India-2011C
13. What type of substances exhibit anti-ferromagnetism?
- Delhi-2008
14. What type of alignment in crystals makes them ferromagnetic?
- Foreign-2008
15. Name an element with which silicon should be doped to give n-type semiconductor.
- Delhi-2008C
16. What type of semiconductor is obtained when silicon is doped with arsenic?
- All India-2010
17. What is meant by intrinsic semiconductor?
- Foreign-2011
18. What is meant by anti-ferromagnetism?
- All India-2014C
19. What type of substances would make better permanent magnets, ferromagnetic or ferrimagnetic?
- Delhi-2013
20. What are n-type semiconductors?
- All India-2012
21. What is meant by 'doping' in a semiconductor?
- Delhi-2012
22. How may the conductivity of an intrinsic semiconductor be increased?
- All India-2012
23. Which stoichiometric defect (point defect) in crystals increases the density of a solid?
- All India-2012
Delhi-2009, 2011
24. What is meant by the term forbidden zone in reference to band theory of solids?
- Foreign-2012
25. Write the type of magnetism observed when the magnetic moments are aligned in parallel and anti-parallel directions in unequal numbers.
- All India-2014
- What type of magnetism is shown by a substance if magnetic moments of domains are arranged in same direction?
- Delhi-2016
26. How do metallic and ionic substances differ in conducting electricity?
- All India-2009
27. What is a semiconductor? What are n-type and p-type semiconductors?
- Odisha Board-2023
28. Which type of magnetic substances are used in permanent magnets? Write their schematic alignment of magnetic moments (domains).
- Karnataka Board-2020
29. Which type of extrinsic semiconductor is formed when silicon is doped with phosphorus? Mention the major charge carrier in it.
- Karnataka Board-2019
30. What is doping? Explain n-type and p-type semi-conductors.
- Andhra Pradesh Board-2018
31. (a) What is semiconductor? Mention the two main types of semiconductor.
(b) Sodium crystallizes in a body-centred cubic (bcc) unit cell. Calculate the approximate number of unit cells in 9.2 g of sodium. (Atomic mass of Na = 23 u).
- Assam Board-2013
32. Fill in the blanks:
(b) Substance which are attracted in Magnetic field are called
- MP Board-2016
33. Fill in the blanks:
(i) The process of adding minute amount of impurity in an element or compound is called
- MP Board-2014

Section-C : Short Answer

1. Explain n-type semi-conductor.
- Rajasthan Board 2022
2. With the help of suitable diagrams on the basis of band theory, explain the difference between (i) a conductor and an insulator.
(ii) a conductor and a semiconductor.
- All India-2008C
3. Explain the following properties giving suitable examples.
(i) Ferromagnetism
(ii) Paramagnetism
(iii) Ferrimagnetism
- Delhi-2008
4. (i) What type of semiconductor is obtained when silicon is doped with boron?
(ii) What type of magnetism is shown in the following alignment of magnetic moments?
(iii) What type of point defect is produced when AgCl is doped with CdCl_2 ?
- Foreign-2008

All India-2013

5. What is a semiconductor? Describe the two main types of semiconductors and explain mechanism for their conduction.
 Delhi-2008, 2008C
 All India-2008, 2008C
6. (i) Based on the nature of intermolecular forces, classify the following solids:
 Sodium sulphate, hydrogen
 (ii) What happen when CdCl_2 is doped with AgCl ?
 (iii) Why do ferromagnetic substances show better magnetism than antiferromagnetic substances?
 All India-2017
7. Define the following with suitable examples
 (a) Anti-ferromagnetism
 (b) Frenkel defect
 Andhra Pradesh Board-2020
8. Explain in short the Band theory in Metals.
 Gujarat Board-2019
9. Explain ferromagnetic substance and anti-ferromagnetic substance.
 Jharkhand Board-2019
10. What is paramagnetism? Give one example.
 Haryana Board-2017
11. What are semiconductors? How are they classified?
 Haryana Board-2018
12. Define Diamagnetic and Ferromagnetic substance.
 Haryana Board-2018
13. Electric conductivities of solid (X) is $10^4 - 10^7 \text{ ohm}^{-1}\text{m}^{-1}$ and solid (Y) is $10^{-20} - 10^{-10} \text{ ohm}^{-1}\text{m}^{-1}$, identified solid (X) and solid (Y) and write their name.
 Rajasthan Board-2017
14. Which type of semiconductor is obtained by doping boron with silicon? Explain.
 Rajasthan Board-2015
15. Explain insulator and semiconductor on the basis of conduction of electricity.
 Rajasthan Board-2013
16. Give the diagram of n-type semiconductor.
 Rajasthan Board-2010
17. (b) Define semiconductor. Classify each of the following as being either a p-type or an n-type semiconductor:
 (i) Ge doped with In
 (ii) B doped with Si
 Assam Board-2020
18. What is meant by ferrimagnetism? Give any two examples.
 Gujarat Board-2018
19. Give reason: Electrical conductivity of silicon increases with increase in temperature.
 Gujarat Board-2019
20. Define semiconductors. Name the kind of semiconductor formed when Si is doped with Ga.
 Assam Board-2016
20. (a) Mention the type of semiconductor, (n-type or p-type) when silicon doped with phosphorus.
 (b) Gold metal crystallizes in a face-centred cubic unit cell (fcc). Determine the density of gold. (Atomic mass of gold = 179 u, atomic radius = 0.144 nm, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$).
 Assam Board-2013
21. Define the following properties of solids:
 (a) Paramagnetism
 (b) Diamagnetism
 (c) Ferromagnetism
 J & K Board-2021

Section-E : Long Answer

1. Describe the two main types of semi-conductors and contrast their conduction mechanism.
 Telangana Board-2017
2. Mention the type of Semiconductor when Si doped with P. A solid compound XY has NaCl structure. If the radius of the cation (X^+) is 100 pm then calculate the radius of the anion(Y^-).
 Assam Board-2022
3. What are semiconductors? How electrical conductivity of semiconductors vary with temperature? Give one example of intrinsic semiconductors.
 Assam Board-2022
4. What are superconductors? Write about their uses.
 Tamil Nadu Board-2011
5. (i) What type of magnetic substances are used to make permanent magnets?
 (ii) Draw the schematic alignment of magnetic moments in ferromagnetic and ferrimagnetic substances.
 Kerala Board-2021
6. Explain the following:
 (a) Ferromagnetism
 (b) Paramagnetism
 Chhattisgarh Board-2020
7. Explain the following:
 (a) Tetrahedral voids
 (b) Doping
 Chhattisgarh Board-2020
8. Give applications of n-type and p-type semiconductors.
 Haryana Board-2018
9. On the basis of molecular band theory, explain conductors and semiconductors.
 Rajasthan Board-2010
10. What are semiconductors? How electrical conductivity of semiconductors vary with temperature? Give one example of intrinsic semiconductor.
 Assam Board-2018
11. What are paramagnetism and ferromagnetism? What type of substances would make better permanent magnets-ferromagnetic or ferrimagnetic?
 Assam Board-2018

A. Types of Solutions**Section-A : Multiple Choice Questions**

1. If 5 gm NaOH is dissolved in 450 ml solution, molarity of solution is.....
 $[Na = 23, O = 16, H = 1 \text{ g mol}^{-1}]$
 (a) 27.8 M (b) 0.278 M
 (c) 2.78 M (d) 278 M

Gujarat Board-2021

Ans. (b)

2. In which solution, solute is liquid and solvent is gas?
 (a) Chloroform mixed with nitrogen gas
 (b) Ethanol dissolved in water
 (c) Camphor in nitrogen gas
 (d) Solution of hydrogen in palladium

Gujarat Board-2021

Ans. (a)

3. The enthalpy change for the chemical reaction $H_2O_{(g)} \rightarrow H_2O_{(l)}$ is called enthalpy of _____.
 (a) vapourisation (b) fusion
 (c) combustion (d) sublimation

Maharashtra board-2022

Ans. (a)

4. Bredig's arc method is used to prepare which of the following sol?
 (a) Silver sol (b) Gelatine sol
 (c) CdS sol (d) As_2S_3 sol

Kerala Board-2020

Ans. (a)

5. Molarity of 900 gm of water is:
 (a) 50 M (b) 55.5 M
 (c) 5 M (d) None of these

Haryana Board-2017

Ans. (b)

6. Isotonic solution are the solutions having same:
 (a) Concentration (b) Osmotic pressure
 (c) Surface tension (d) Viscosity

Haryana Board-2018

Ans. (b)

7. Choose the correct answer:

When temperature of a solution increases then–
 (a) Molarity decreases and molality increases
 (b) Molality decreases and molarity increases
 (c) No change occur for both molarity and molality
 (d) Molarity decreases and no change in molality.

Assam Board-2020

Ans. (d)

8. Which of the following aqueous solution has highest boiling point?
 (a) 0.1 m NaCl (b) 0.2 m $Ba(NO_3)_2$
 (c) 0.01 m Na_3PO_4 (d) 0.03 m KNO_3

Gujarat Board-2019

Ans. (b)

9. Calculate Molarity (M) for the solution of 0.1 molal (m) NaOH solution whose density is 1.25 g mL^{-1} .
 (a) 0.135 M (b) 0.125 M
 (c) 0.129 M (d) 0.100 M

Gujarat Board-2020

Ans. (b)

10. Which of the following concentration of solution depends on temperature?
 (a) molality (b) molarity
 (c) mass% (d) mole fraction

Assam Board-2017

Ans. (b)

11. No. of moles of solute present in 1000 gm of solvent is known as:
 (a) Normality (b) Molality
 (c) Molarity (d) Mole fraction

MP Board-2012

Ans. (b)

12. Liquid in Liquid colloidal system are called
 (a) aerosols (b) foams
 (c) gels (d) emulsion

Nagaland Board-2020

Ans. (d)

13. Which of the following is aerosol?
 (a) Somke (b) Soap lather
 (c) Milk (d) Butter

Jharkhand Board-2023

Ans. (a)

14. The process of setting of colloidal particles is called
 (a) electrophoresis (b) peptization
 (c) coagulation (d) dialysis

Jharkhand Board-2023

Ans. (c)

15. Fog is an example of colloidal system of
 (a) liquid dispersed in gas
 (b) gas dispersed in gas
 (c) solid dispersed in gas
 (d) solid dispersed in liquid

Nagaland Board-2018

Ans. (a)

Section-B : Very Short Answer	
1. What are isotonic solutions? Haryana Board 2023	22. What is Osmosis? What are isotonic solutions? Write the biological importance of osmotic pressure. Chhattisgarh Board-2021
2. (a) Write three differences between Lyophobic sol and Lyophilic sol. CBSE-2022	23. What is formalin ? Chhattisgarh Board-2021
3. Write two differences between an ideal solution and a non-ideal solution. CBSE-2019	24. Calculate the molarity of a solution containing 1.0g of NaOH in 250 mL solution. Assam Board-2014
4. What are isotonic solutions? All India 2014, 12	25. What are Isotonic solutions? Given ans examples. Andhra Pradesh Board-2021
5. What is difference between diffusion and effusion? NIOS Board-2021	26. Number of moles of the solute per kilogram of the solvent is (a) Mole fraction (b) Molality (c) Molarity (d) Molar mass Kerala Board-2016
6. What is Binary Solution? Karnataka Board-2014	27. Write definition of azeotropic mixture. Rajasthan Board-2019
7. Ornamental gold containing copper is an example for what type of solution? Karnataka Board-2016	28. What is the relation of bond order with bond energy and the stability of a bond? Rajasthan Board-2011
8. Name the process usually employed for the purification of Nickel. Karnataka Board-2015	29. Define the following terms: (iii) Mole fraction Assam Board-2020
9. Mention the enthalpy of mixing ($\Delta_{\text{mix}}H$) value to form an ideal solution. Karnataka Board-2014	30. Define the terms: (a) Solute (b) Solution Haryana Board-2016
10. What are cohesive and adhesive forces? How do they govern the wetting and non-wetting properties of liquids? NIOS Board-2016	31. Give the definition of solubility of a substance. Assam Board-2018
11. How is a sol different from an emulsion ? NIOS Board-2015	32. Give one example each of oil in water emulsion and water in oil emulsion. Meghalaya Board-2018
12. Differentiate between lyophilic sols and lyophobic sols. NIOS Board-2014	
13. Differentiate between diffusion and effusion. NIOS Board-2012	
14. Among Cheese, cloud, smoke, is Gel. Haryana Board-2022	
15. Define Azeotrope mixture. Haryana Board-2019	
16. What is observed when electric current passed through a colloidal sol. Haryana Board-2021	
17. Give an example for liquid solution in which solute is gas. Karnataka Board-2015	
18. Which is the dispersed phase in Emulsion? Karnataka Board-2016	
19. In a binary solution. Mole fraction of one component is 0.068. What is the Mole fraction of another component ? Karnataka Board-2018	
20. Write dispersed phase and dispersion medium of milk, a colloidal solution. Jharkhand Board-2019	
21. Briefly explain the different types of emulsions and give example for each. Kerala Board-2019	
Section-C : Short Answer	
	1. Write three difference between lyophobic sol and lyophilic sol. CBSE-2020
	2. Outer hard shells of two eggs are removed one of the egg is placed in pure water and the other is placed in saturated solution of sodium chloride. What will be observed and why? All India 2010C
	3. Define molality of a solution. Assam Board-2022
	4. (a) What are Isotonic, Hypotonic and Hypertonic solution? Uttarakhand Board-2020
	5. What is solid solution? Explain their type with illustration. Gujarat Board-2016
	6. What are buffer solution ? Out of the following substances, pick up two pairs of substances such that one pair would make an acidic buffer and the other one a basic buffer. BaCl_2 , HF, HNO_3 , $(\text{NH}_4)_2\text{SO}_4$, NaF, NH_4OH , Na_2SO_4 and $\text{Al}(\text{OH})_3$ NIOS Board-2022

- 7.** **Calculate :**
(a) Molality
(b) Molarity
(c) Mole fraction of KI
If the density of 20% (mass/mass) aqueous solution of KI is 1.202 gm L⁻¹.

8. **Define the following terms:**
(i) Molality
(ii) Osmotic pressure

Haryana Board-2018

9. **Define molality of a solution.**

Assam Board-2019

10. **State Henry's law and mention its two important applications.**

Assam Board-2012

11. **Write three differences in solution having positive deviation and negative deviation.**

MP Board-2017

12. **What are lyophobic and lyophilic sols ? Give their chief characteristics.**

J&K Board-2020

13. **Identify the positively charged sol:**
(a) Haemoglobin
(b) As₂S₃
(c) Clay
(d) Gold sol

J & K Board-2021

Section-E : Long Answer

1. **(a) Predict the nature of the aqueous solutions of the following substances.**
(i) NaCN (ii) Na₂CO₃ (iii) CH₃COONH₄ (iv) Na₂SO₄ (v) FeCl₃ and (vi) CuCl₂

Odisha Board-2017

2. **In a first order reaction, the reactant concentration decreases from 0.8M to 0.4M in 15 min. What is the time taken for the concentration to change from 0.1M to 0.025M?**

Odisha Board-2017

3. **(i) What are lyophilic and lyophobic sols ? Give one example for each type.
(ii) Explain the different types of emulsions.**

Kerala Board-2021

4. **Why is boiling point of H₂O higher than H₂S? Explain with reason.**

Rajasthan Board-2010

5. **Why is density of ice lower than density of water? Explain with reason.**

Rajasthan Board-2010

6. **(a) Define the following:
(i) Molarity
(ii) Molality
(b) Determine the molarity of a solution of 4.0 gram per litre concentration of NaOH.**

B. Expression of Concentration of solution

Section-A : Multiple Choice Questions

- 1. A Molal solution is one that contains one Mole of a solute in-**

 - (a) 1000 gram of the solvent
 - (b) One litre of the solution
 - (c) One litre of the solvent
 - (d) 22.4 litres of the solution

Uttarakhand Board 2023

Ans. (a)

CBSE-2020

Ans. (d)

Gujarat Board-2021

Ans. (a)

4. Which unit of concentration value does not change with change in temperature?

 - (a) Normality
 - (b) Molarity
 - (c) Molality
 - (d) %V/V

Gujarat Board-2019

Ans. (c)

- 5. Degree of ionization does not depend on :**

 - (a) Nature of solvent
 - (b) Nature of electrolyte
 - (c) Dilution
 - (d) Molecular weight of the electrolyte

NIOS Board-2022

Ans. (d)

NIOS Board-2023

Ans. (d)

Haryana Board-2021

Ans. (d)

8. In calculating osmotic pressure, the concentration of solute is expressed in ____.

 - (a) molarity
 - (b) molality
 - (c) mole fraction
 - (d) percentage mass

Maharashtra board-2022

Ans. (a)

9. The pH of weak monoacidic base is 11.2, its OH^- ion concentration is :
- 1.585×10^{-3} mol dm $^{-3}$
 - 3.010×10^{-11} mol dm $^{-3}$
 - 3.010×10^{-3} mol dm $^{-3}$
 - 1.585×10^{-11} mol dm $^{-3}$

Maharashtra board-2023

Ans. (a)

10. What is the name of the colloidal system in which both the dispersed phase and dispersion medium are liquids?
- Emulsions
 - Gel
 - Sol
 - Foam

Kerala Board-2022

Ans. (a)

11. Mole fraction of a solute in 2.5 molal aqueous solution is:
- | | |
|----------|-----------|
| (a) 0.43 | (b) 0.043 |
| (c) 4.3 | (d) 43 |

Haryana Board-2017

Ans. (d)

12. Full form of CMC is:
- Critical molar Concentration
 - Critical micelle Concentration
 - Constant micelle Concentration
 - Common micelle Concentration

Haryana Board -2016

Ans. (d)

13. 10 gm caustic soda (molar mass = 40) is dissolved in 500 cm 3 solution. Its molarity is
- | | |
|-----------|-----------|
| (a) 2.0 M | (b) 1.5 m |
| (c) 1.0 m | (d) 0.5m |

Rajasthan Board-2010

Ans. (d)

14. How many gms of glucose are required to prepare 1 kg solution of glucose having concentration 10% w/w?
- | | |
|---------|---------|
| (a) 1 | (b) 100 |
| (c) 0.1 | (d) 10 |

Gujarat Board-2016

Ans. (b)

15. Which of the following aqueous solution has the highest boiling point having concentration 0.050 m?
- | | |
|---|-------------------------------------|
| (a) NaCl | (b) Urea |
| (c) K ₃ [Fe(CN) ₆] | (d) Na ₂ SO ₄ |

Gujarat Board-2018

Ans. (c) :

16. What is the normality of 0.2 M H₃PO₄ solution?
- | | |
|-----------|-----------|
| (a) 0.2 N | (b) 0.1 N |
| (c) 0.4 N | (d) 0.6 N |

Gujarat Board-2017

Ans.(c)

17. Which of the following solution is isotonic with 0.1 M aqueous solution of urea?
- | | |
|------------------|----------------|
| (a) 0.05 M NaCl | (b) 0.1 M NaCl |
| (c) 0.025 M NaCl | (d) 1M NaCl |

Gujarat Board-2017

Ans.(a)

18. How much litre of dihydrogen gas will be produced at STP, in the reaction of ethanol with 12 gram Mg? (Mg=24gram/mole).
- | |
|----------------|
| (a) 11.2 litre |
| (b) 22.4 litre |
| (c) 2.24 litre |
| (d) 5.6 litre |

Gujarat Board-2019

Ans. (a)

19. What is the weight to volume ppm of 0.05% w/v CaCl₂ aqueous solution?
- | |
|----------|
| (a) 500 |
| (b) 0.05 |
| (c) 50 |
| (d) 5 |

Gujarat Board-2019

Ans. (a)

20. Increasing the temperature of an aqueous solution will cause
- decrease in molality
 - decrease in molarity
 - decrease in mole fraction
 - decrease in mass percent

Meghalaya Board-2019

Ans. (b) :

21. The molarity of the solution containing 5 g of NaOH in 500 ml of aqueous solution is
- | |
|-------------|
| (a) 1 M |
| (b) 2.5 M |
| (c) 0.25 M |
| (d) 0.025 M |

Jharkhand Board-2023

Ans. (c)

Section-B : Very Short Answer

- Find molality of pure water (H₂O = 18). MP Board 2020
- Define molarity [M]. How does molarity vary with temperature? Karnataka board 2023
- Calculate the Mass percentage of benzene and carbon tetrachloride if 22g of benzene dissolved in 122 g of carbon tetrachloride.

OR

6×10^{-3} g of oxygen dissolved in one liter sea water (1030 g). What is the concentration of oxygen in ppm.

Uttarakhand Board 2022

- The of the boiling point of solvent by the addition of a solute isproportional to the molality of the solutions.

ISC Board-2009

5. The pressure of an aqueous solution of 0.1 M cane sugar is than that of pure water.
ISC Board-2010
6. Calculate the mole fraction of water in a sodium hydroxide solution which has 80 g of NaOH and 54 g of H₂O. (Relative atomic masses of Na = 23, O = 16, H = 1)
ISC Board-2005
7. If the molality of an aqueous solution of cane sugar is 0.4445, what is the mole fraction of cane sugar?
ISC Board-2008
8. 46 g of ethyl alcohol is dissolved in 18 g of water. Calculate the mole fraction of ethyl alcohol.
(Atomic weight of C = 12, O = 16, H = 1)
ISC Board-2011
9. Distinguish between the terms molality and molarity. Under what conditions are the molarity and molality of a solution nearly the same?
All India 2008C
10. State the main advantage of molality over molarity as the unit of concentration.
Delhi 2010, 2009C
11. What is meant by molality of the solution?
All India 2009
12. Define the following terms:
 (i) mole fraction (χ)
 (ii) molality of a solution (m)
All India 2015C
13. Calculate the molarity of 9.8% (w/w) solution of H₂SO₄ if the density of the solution is 1.02 g mL⁻¹.
[Molar mass of H₂SO₄ = 98 g mol⁻¹]
Foreign 2014
14. Differentiate between molarity and molality of a solution. How can we change molality value of a solution into molarity value?
Delhi 2014C; Foreign 2011
15. A solution of glucose (C₆H₁₂O₆) in water is labelled as 10% by weight. What would be the molality of the solution? (Molar mass of glucose = 180 g mol⁻¹)
All India 2013
16. If the density of water of a lake is 1.25 g mL⁻¹ and 1 kg of lake water contains 92 g of Na⁺ ions, calculate the molarity of Na⁺ ions in this lake water. (Atomic mass of Na = 23 g mol⁻¹).
HOTS; Foreign 2012, 2008
17. Differentiate between molarity and molality for a solution. How does a change in temperature influence their values?
Delhi 2011, 2009; Foreign 2011, 2009
18. Define the term mole fraction.
All India 2012, 2010C, 2009; Delhi 2012
19. 2.75 g of Na₂CO₃ is present in 200 ml Na₂CO₃ solution. Calculate the molarity of the solution.
Odisha Board-2020
20. Calculate the mass of NaOH required to prepare 2 litres of 1.02 $\frac{N}{10}$ solution.
Odisha Board-2023
21. How many molecules are present in 100 g sample of NH₃?
NIOS Board-2018
22. The following data were obtained when nitrogen and oxygen react together to form different compounds :

Mass of nitrogen	Mass of oxygen
(i)	14 g
(ii)	14g
	32g

 Which law of chemical combination is obeyed by the above experimental data ?
Define this law.
NIOS Board-2019
23. 4 g of copper chloride was found to contain 1.890 g of copper and 2.110 g of chlorine. Calculate the percentage of copper and chlorine in it.
NIOS Board-2021
24. Define Molarity.
Karnataka Board-2014
25. How does the size of blood cells change when placed in an aqueous solution containing more than 0.9% (m/v) sodium chloride?
Karnataka Board-2019
26. How does molarity varies with temperature?
Karnataka Board-2017
27. 10 mL of liquid 'A' is mixed with 10 mL of liquid 'B', the volume of the resultant solution is 19.9 mL. What type of deviation expected from Raoult's Law ?
Karnataka Board-2017
28. How many moles of AgCl will be precipitated when an excess of AgNO₃ solution is added to one molar solution of [CrCl(H₂O)₅]Cl₂?
Karnataka Board-2015
29. In the given reaction 2A + 4B \rightarrow 3C + 4D, when 5 moles of A react with 6 moles of B, then—
 (a) write which species is the limiting reagent;
 (b) calculate the amount of C formed.
NIOS Board-2016
30. Which reagent is used for oxidizing primary alcohols to aldehydes?
NIOS Board-2016
31. Write the names of two important types of compound lipids.
NIOS Board-2016
32. Calculate the number of carbon-12 atoms in (a) 96 u and (b) 96 moles of carbon-12 sample.
[Given, atomic mass of C = 12 u and N_A = 6.022 $\times 10^{23}$ mol⁻¹]
NIOS Board-2011

6. Explain the Henry's law about dissolution of a gas in a liquid.

All India 2012, 2011;
Delhi 2011; Foreign 2011

7. What is diffusion?

NIOS Board-2015

8. State Henry's law.

Karnataka Board-2018

9. Name the law behind the dissolution of CO_2 gas in soft drinks under high pressure.

Karnataka Board-2016

10. What role does the Molecular interaction play in a solution of alcohol and water ?

Haryana Board-2021

11. What is a weak electrolyte ?

Haryana Board-2021

12. What is the effect of rise in temperature on the solubility of gasses in liquids?

Karnataka Board-2016

13. State Henry's law.

Karnataka Board-2018

14. Why does the conductivity of a solution decrease with dilution?

Karnataka Board-2018

15. Define : Acidic buffer solution. Write the relationship between solubility and solubility product for PbI_2 .

Maharashtra board-2023

16. State Henry's law and mention any one of its application.

Kerala Board-2022

17. (a) Differentiate between dispersed phase and dispersed medium on the basis of interaction with an example.

Nagaland Board-2021

18. Define vant- Hoff's factor.

Nagaland Board-2017

Section-C : Short Answer

1. An aqueous solution containing 12.48 g of barium chloride in 1.0 kg of water boils at 373.0832 K. Calculate the degree of dissociation of barium chloride (Given, K_b for $\text{H}_2\text{O} = 0.52 \text{ K mol}^{-1}$, molar mass of $\text{BaCl}_2 = 208.34 \text{ g mol}^{-1}$).

Delhi 2011C

2. State Henry's Law. Give two applications of it.

Kerala Board-2021

3. Generally solubility of gases in liquids is decreases as increasing temperature. Give reason.

Rajasthan Board-2018

4. How is nitric acid prepared by Ostwald's process? Give the reaction involved.

Nagaland Board-2020

Section-E : Long Answer

1. Briefly explain the effects of temperature on the solubility of solids in liquids.

Haryana Board-2017

d. Colligative Properties and Determination of Molar Mass

Section-A : Multiple Choice Questions

1. Elevation in boiling point of the aqueous solution of 0.01 M BaCl_2 compare to 0.01 M urea is _____.
 (a) approximately half
 (b) equal
 (c) approximately three times
 (d) approximately twice

Gujarat Board 2023 (March)

Ans. (c)

2. The aqueous solution having maximum boiling point is
 (a) 0.015 M glucose
 (b) 0.01 M KNO_3
 (c) 0.015 M urea
 (d) 0.01 M Na_2SO_4

UP Board 2019

Ans. (d)

3. The concentration unit independent of temperature is –
 (a) Normality
 (b) Mass-volume percentage
 (c) Molality
 (d) Molarity

UP Board 2023

Ans. (c)

4. Assertion (A) : Elevation in boiling point is a colligative property.
 Reason (R) : Elevation in boiling point is directly proportional to molarity.
 (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is wrong statement.
 (d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

Ans. (0)

5. 18 g of glucose is dissolved in 1kg of water at what temp will the water boil , K_b for water is $0.52 \text{ K kg mol}^{-1}$
 (a) 373.2 K
 (b) 378.2 K
 (c) 381.5 K

Punjab Board-2021

Ans. (a)

6. Which of the following aqueous solutions should have the highest boiling point :
 (a) 1.0 M NaOH
 (b) 1.0 M Na_2SO_4
 (c) 1.0 M NH_4NO_3
 (d) 1.0 M KNO_3

Punjab Board-2021

Ans. (b)

7. Colligative properties depends upon :
- Nature of solute particles present in the Solution.
 - Number of solute particles present in the solution
 - Physical properties of the solute particles
 - Nature of the solvent particles

Punjab Board-2021

Ans. (b)

8. Temperature increases, the value of K_H increases, thus the value of solubility of gaseous solute will be.....
- Remains constant
 - Decreases
 - Increases
 - Cannot say

Gujarat Board-2019

Ans. (b)

9. Colligative properties of solution depends on :
- Molarity
 - Number of moles of solute
 - Number of moles of solvent
 - Mole fractions

Haryana Board-2016

Ans. (b)

10. What is the concentration of solution in ppm when 5.0×10^{-5} gm CO_2 is dissolved in 100 ml solution.
- 500
 - 0.5
 - 5
 - 5.0×10^{-5}

Gujarat Board-2018

Ans.(b) :

11. Which of the following is an example for interstitial solid solution.
- Tic
 - Li_2C_2
 - Sic
 - Al_4C_3

Gujarat Board-2018

Ans.(a) :

12. Which of the following is a colligative property?
- Osmotic pressure
 - Melting point
 - Boiling point
 - None of these

Haryana Board-2016

Ans. (a)

13. Colligative properties are those properties which depend on
- shapes of the particles
 - nature of the particles only
 - nature of the solvent only
 - number of particles only

Meghalaya Board-2019

Ans. (d) :

14. Relative lowering in vapour pressure is equal to
- molarity of solution
 - molality of solution
 - mole fraction of solute
 - mole fraction of solvent

Jharkhand Board-2023

Ans. (c)

Section-B : Very Short Answer

1. Explain mole fraction.

(or)

Define Molarity.

MP Board 2020

2. (i) What are Colligative properties?

Kerala Board 2023

3. Write any two colligative properties

Kerala Board 2023

4. Define Osmotic pressure. How will you show that Osmotic pressure is a colligative property ?

UP Board 2023

5. 45 g of ethylene glycol ($\text{C}_2\text{H}_6\text{O}$) is mixed with 600 g of water. Calculate the Freezing point depression (ΔT_f) of solution.

Uttarakhand Board 2022

6. Calculate the amount of calcium chloride (Molar mass = 111 g mol^{-1}) which must be added to 500 g of water to lower its freezing point by 2 K, assuming calcium chloride is completely dissociated [K_f for water = $1.86 \text{ K kg mol}^{-1}$]

CBSE-2020

7. Why does a solution containing non-volatile solute have a higher boiling point than pure solvent ? Why is elevation of boiling point a colligative property ?

CBSE-2020, 2019

8. A solution of lactose containing 8.45 g of lactose in 100 g of water has a vapour pressure of 4.559 mm of Hg at 0°C . If the vapour pressure of pure water is 4.579 mm of Hg, calculate the molecular weight of lactose.

ISC Board-2012

9. The osmotic pressure of 0.01 molar solution of an electrolyte is found to be 0.65 atm at 27°C . Calculate the van't Hoff factor. What conclusion can you draw about the molecular state of the solute in the solution ?

ISC Board-2011

10. An aqueous solution containing 0.2 g of compound A in 21.7 g of water freezes at 272.914 K. If the value of K_f for water is $1.86 \text{ K kg mol}^{-1}$, calculate molecular weight of compound A.

ISC Board-2004

11. What is a colligative property ? Give two examples.

ISC Board-2003

12. Why does soda water fizz when the bottle is opened ? Name the law that explains this phenomenon.

ISC Board-2004

13. A decinormal solution of sodium chloride exerts an osmotic pressure of 4.82 atm at 27°C . Calculate the degree of dissociation of sodium chloride.

ISC Board-2007

14. An aqueous solution containing 1.70 g of cane sugar in 100 mL water begins to freeze at -0.093°C . The cryoscopic constant (molal depression constant) of water is 1.86 kg mol^{-1} . Calculate the molecular weight of cane sugar.
ISC Board-2007
15. The freezing point of a solution containing 0.3 g of acetic acid in 30 g of benzene is lowered by 0.45 K . Calculate the van't Hoff factor. (Atomic weight of C = 12, H = 1, O = 16, K_f for benzene = $5.12 \text{ K kg mol}^{-1}$)
ISC Board-2013
16. A solution of urea in water has a boiling point of 100.18°C . Calculate the freezing point of the solution. (K_f for water is $1.86 \text{ K kg mol}^{-1}$ and K_b for water is $0.512 \text{ K kg mol}^{-1}$)
ISC Board-2012
17. The boiling point of pure water is 373 K . Calculate the boiling point of an aqueous solution containing 18 g of glucose (W = 180) in 100 g of water. Molal elevation constant of water is $0.52 \text{ K kg mol}^{-1}$.
ISC Board-2009
18. Correct the given statement : "Osmotic pressure and boiling point are colligative properties".
ISC Board-2004
20. Which is colligative property among the following: Polysaccharide, osmotic pressure, aldol condensation, polarimeter?
ISC Board-2013
21. What is meant by colligative properties?
All India 2009
22. Define the following terms:
 (i) Colligative properties
 (ii) Molality (m)
Delhi 2017
23. Explain boiling point elevation constant for a solvent or ebullioscopic constant.
All India 2012; foreign 2012
24. Explain Tyndall effect.
Odisha Board-2020
25. Calculate the freezing point of a solution containing 60 g of glucose (Molar mass = 180 g mol^{-1}) in 250 g of water. (K_f of water = $1.86 \text{ K kg mol}^{-1}$).
UP Board-2018
26. State Kohlrausch's law.
Manipur Board-2018
27. Why are lyophilic sols more stable than lyophobic sols?
Manipur Board-2018
28. Calculate the molar mass of argon if the mass of single argon atom is $6.634 \times 10^{-26} \text{ kg}$.
NIOS Board-2023
29. What is molar mass of a substance? How many entities are present in it?
NIOS Board-2023
30. Define molar volume of a substance. What is the molar volume of an ideal gas at S.T.P.? What values of standard temperature and pressure are taken in this case?
NIOS Board-2021
31. What is meant by molar volume ? How is it related with density ? What are the STP conditions at which molar volume is measured ?
NIOS Board-2021
32. In an experiment 5.0 g of CaCO_3 on heating gave 2.8 g CaO and 2.2 g CO_2 . Show that these results are in accordance with the law of conservation of mass.
NIOS Board-2019
33. Calculate the molar mass of argon atoms, if the mass of a single argon atom is $6.634 \times 10^{-26} \text{ kg}$.
NIOS Board-2018
34. On mixing equal volumes of acetone and ethanol. What type of deviation from Raoul's law is expected?
Karnataka Board-2015
35. Define molar mass of a molecular substance.
NIOS Board-2015, 2011
36. What is relative lowering of vapour pressure ?
Andhra Pradesh Board-2019
37. On what factor the value of colligative property depends?
Karnataka Board-2015
38. Derive the relation between elevation of boiling point and molar mass of solute.
Maharashtra board-2018
39. Derive van't Hoff general solution equation.
Maharashtra board-2019
40. Calculate the elevation in boiling point when 300g of urea, $\text{CO(NH}_2\text{)}_2$ is dissolved in 2500g of water. (Given : K_b for water = $0.52 \text{ K Kg mol}^{-1}$)
Manipur Board-2019
41. Define the following terms:
 (i) Krafft temperature
 (ii) Van't Hoff factor
Assam Board-2020
42. Colloidal dispersion of a liquid in a gas is called
J&K Board-2020
43. The boiling point of benzene is 353.23 K . When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K . Calculate the molar mass of the solute, K_b for benzene is $2.53 \text{ K kg mol}^{-1}$.
Meghalaya Board-2021

Section-C : Short Answer

1. At 20°C , on dissolving 10 g of a non volatile non-electrolyte substance in 100 g of water, vapour pressure decreases from 17.535 mm to 17.235 mm. Calculate the molecular weight of solute.
UP Board 2019

2. At 20°C the osmotic pressure of 45 g per litre solution of a substance is 3.2 atmosphere. Calculate the value of solution constant. The molecular weight of the substance is 342.
UP Board 2019
- For Questions number 3 to 6, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
 - (b) Both Assertion (A) and Reason (R) true, but Reason (R) is not the correct explanation of the Assertion (A).
 - (c) Assertion (A) is true, but Reason (R) is false
 - (d) Assertion (A) is false, but Reason (R) is true.
3. Assertion (A) : When NaCl is added to water, a depression in freezing point observed.
Reason (R) : The vapour pressure of solution is increased which causes depression in freezing point.
Gujarat Board 2023 (July)
4. Establish the relationship between the relative lowering of vapour pressure of a solution and mole fraction of the solute in it when the solvent alone is volatile.
Manipur Board 2020
5. Concentrated aqueous ammonia contains 1.00 mol NH₃ dissolved in 2.44 mol H₂O. Calculate the molal concentration of the ammonia solution?
Manipur Board 2023
6. A 0.01 m aqueous solution of AlCl₃ freezes at -0.068 °C. Calculate the percentage of dissociation. [Given : K_f for Water = 1.86 kg mol⁻¹]
CBSE-2020
7. The freezing point of a solution containing 5g of benzoic acid ($M = 122 \text{ g mol}^{-1}$) in 35g of benzene is depressed by 2.94 K. What is the percentage association of benzoic acid if it forms a dimer in solution?
(K_f for benzene = 4.9 K kg mol⁻¹)
CBSE-2020
8. An antifreeze solution is prepared by dissolving 31 g of ethylene glycol (Molar mass = 62 g mol⁻¹) in 600 g of water. Calculate the freezing point of solution. (K_f for water = 1.86 K kg mol⁻¹)
CBSE-2020
9. Calculate the mass of ascorbic acid (Molar mass = 176 g mol⁻¹) to be dissolved in 75 g of acetic acid, to lower its freezing point by 1.5°C
(K_f = 3.9 K kg mol⁻¹)
CBSE-2020
10. A 0.01 m aqueous solution of AlCl₃ freezes at -0.068 °C. Calculate the percentage of dissociation. [Given : K_f for Water = 1.86 K kg mol⁻¹]
CBSE-2020
11. (b) (i) Write the dispersed phase and dispersion medium of 'milk'.
(ii) What is the cause of Brownian movement in colloidal particles ?
(iii) Why does physisorption decrease with increase in temperature ?
CBSE-2022
12. (a) (i) Define coagulation.
(ii) State Hardy-Schulze rule.
(iii) What is Electrophoresis ?
CBSE-2022
13. A solution containing 8 g of substance in 100 g of diethyl ether boils at 36.86°C whereas pure ether boils at 35.60°C. Determine the molar mass of the solute. [For ether K_b = 2.02 K kg mol⁻¹]
CBSE-2019
14. (a) Out of 0.1 molal aqueous solution of glucose and 0.1 molal aqueous solution of KCl, which one will have higher boiling point and why ?
(b) Predict whether van't Hoff factor, (i) is less than one or greater than one in the following :
(i) CH₃COOH dissolved in water
(ii) CH₃COOH dissolved in benzene
CBSE-2019
15. (i) A solution containing 0.5 g of KCl dissolves in 100 g of water and freezes at -0.24°C. Calculate the degree of dissociation of the salt. (K_f for water = 1.86°C). (Atomic weights of K = 39, Cl = 35.5)
(ii) If 1.71 g of sugar (molar mass = 342) are dissolved in 500 mL of an aqueous solution at 300 K, what will be its osmotic pressure ?
(iii) 0.70 g of an organic compound when dissolved in 32 g of acetone produces an elevation of 0.25°C in the boiling point. Calculate the molecular mass of organic compound.
(K_b for acetone = 1.72 K kg mol⁻¹)
ISC Board-2015
16. (i) Determine the freezing point of a solution containing 0.625 g of glucose (C₆H₁₂O₆) dissolved in 102.8 g of water.
(Freezing point of water = 273 K, K_f for water = 1.87 K kg mol⁻¹, at wt.)
(C = 12, H = 1, O = 16)
(ii) A 0.15 M aqueous solution of KCl exerts an osmotic pressure of 6.8 atm at 310 K. Calculate the degree of dissociation of KCl. (R = 0.0821 L atm K⁻¹ mol⁻¹).
(iii) A solution containing 8.44 g of sucrose in 100 g of water has a vapour pressure 4.56 mm of Hg at 273 K. If the vapour pressure of pure water is 4.58 mm of Hg at the same temperature, calculate the molecular weight of sucrose.
ISC Board-2017

17. Calculate the depression in freezing point of water when 20.0 g of $\text{CH}_3\text{CH}_2\text{CHClCOOH}$ is added to 500 g of water. (Given, $K_a = 1.4 \times 10^{-3}$, $K_f = 1.86 \text{ K kg mol}^{-1}$).
HOTS; Delhi 2008C
18. A 5% solution (by mass) of cane sugar in water has a freezing point of 271 K. calculate the freezing point of 5% (by mass) solution of glucose in water. The freezing point of pure water is 273.15 K (Molar mass of cane sugar = 342 g mol^{-1} and molar mass of glucose = 180 g mol^{-1}).
Foreign 2008
19. Calculate the freezing point depression expected for 0.0711 m aqueous solution of Na_2SO_4 . If this solution actually freezes at -0.320°C , what would be the value of van't Hoff factor? (K_f for water is $1.86^\circ\text{C mol}^{-1}$).
Delhi 2009; Foreign 2009
20. Calculate the freezing point of a solution containing 18 g glucose, $\text{C}_6\text{H}_{12}\text{O}_6$ and 68.4 g sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ in 200 g of water. The freezing point of pure water is 273 K and K_f for water is $1.86 \text{ K kg mol}^{-1}$.
HOTS; All India 2009C
21. What mass of ethylene glycol (molar mass 62.0 g mol^{-1}) must be added to 5.50 kg of water to lower the freezing point of water from 0°C to -10.0°C ? (K_f for water = $1.86 \text{ K kg mol}^{-1}$).
All India 2010
22. 0.1 mole of acetic acid was dissolved in 1 kg of benzene. Depression in freezing point of benzene was determined to be 0.256 K. What conclusion can you draw about the state of the solute in solution?
(Given, K_f for benzene = 5.12 Kmol^{-1}).
Delhi 2010C
23. Phenol associates in benzene to a certain extent to form a dimer. A solution containing 20 g of phenol in 1.0 kg of benzene has its freezing point lowered by 0.69 K. Calculate the fraction of phenol that has dimerised.
(Given, K_f for benzene = 5.1 Kmol^{-1}).
HOTS; Delhi 2011C
24. Calculate the freezing point of an aqueous solution containing 10.50 g of MgBr_2 in 200 g of water (molar mass of $\text{MgBr}_2 = 184 \text{ g}$, K_f for water is $1.86 \text{ K kg mol}^{-1}$).
Delhi 2011
25. Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250.0 g of water. (K_b for water = $0.512 \text{ K kg mol}^{-1}$, molar mass of $\text{NaCl} = 58.44 \text{ g mol}^{-1}$).
Delhi 2011
26. What would be the molar mass of a compound if 6.21 g of it dissolved in 24.0 g of chloroform form a solution that has a boiling point of 68.4°C . the boiling point of pure chloroform is 61.7°C and the boiling point elevation constant, K_b for chloroform is 3.63°C/mol .
Delhi 2011
27. A 5% solution (by mass) of cane-sugar in water has freezing point of 271 K. Calculate the freezing point of 5% solution (by mass) of glucose in water of the freezing point of pure water is 273.15 K. [Molecular masses glucose $\text{C}_6\text{H}_{12}\text{O}_6 = 180 \text{ amu}$ cane-sugar $\text{C}_{12}\text{H}_{22}\text{O}_{11} = 342 \text{ amu}]$
28. Calculate the boiling point elevation for a solution prepared by adding 10 g of CaCl_2 to 200 g of water. (K_b for water = $0.52 \text{ K kg mol}^{-1}$, molar mass of $\text{CaCl}_2 = 111 \text{ g mol}^{-1}$).
Foreign 2014
29. Some ethylene glycol, $\text{HOCH}_2\text{CH}_2\text{OH}$, is added to your car's cooling system along with 5 kg of water. If the freezing point of water-glycol solution is -15.0°C , what is ($K_b = 0.52 \text{ K kg mol}^{-1}$ and $K_f = 1.86 \text{ K kg mol}^{-1}$ for water)
Delhi 2014C
30. The depression in freezing point of water observed for the same molar concentrations of acetic acid, trichloroacetic acid and trifluoroacetic acid increases in the order as stated above. Explain.
Delhi 2008C
31. A 10% solution (by mass) of sucrose in water has freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water, if freezing point of pure water is 273.15 K.
Given : Molar mass of sucrose = 342 g mol^{-1} and Molar mass of glucose = 180 g mol^{-1} .
All India 2017
32. Calculate the boiling point of solution when 4 g of MgSO_4 ($M = 120 \text{ g mol}^{-1}$) was dissolved in 100 g of water assuming MgSO_4 undergoes complete ionisation.
(K_b for water = $0.52 \text{ K kg mol}^{-1}$).
All India 2016
33. Calculate the mass of NaCl (molar mass = 58.5 g mol^{-1}) to be dissolved in 37.2 g of water to lower the freezing point by 2°C , assuming that NaCl undergoes complete dissociation. (K_f for water = $1.86 \text{ K kg mol}^{-1}$).
Foreign 2015
34. What mass of NaCl must be dissolved in 65.0 g of water to lower the freezing point of water by 7.50°C ? The freezing point depression constant (K_f) for water is 1.86°C/mol . Assume van't Hoff factor for NaCl is 1.87. (molar mass of $\text{NaCl} = 58.5 \text{ g mol}^{-1}$).
All India 2011, 2010; foreign 2010
35. 45 g of ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) is mixed with 600 g of water. Calculate
(i) the freezing point depression and
(ii) the freezing point of the solution.
(Given, K_f of water = $1.86 \text{ K kg mol}^{-1}$).
Delhi 2015C
36. Find the boiling point of a solution containing 0.520 g of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) dissolved in 80.2 g of water [Given, K_b for water = 0.52 Km^{-1}].

37. Find the freezing point of a solution containing 0.520 g glucose ($C_6H_{12}O_6$) dissolved in 80.2 g of water [Given, K_f for water = 1.86 Km^{-1}].
All India 2010C
38. The molecular masses of polymers are determined by osmotic pressure method and not by measuring other colligative properties. Give two reasons.
All India 2011C
39. Define the terms: osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property? Explain.
Delhi 2011
40. Why does a solution containing non-volatile solute have higher boiling point than the pure solvent? Why is elevation of boiling point a colligative property?
All India 2015
41. Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K ($k_f = 5.12 \text{ K kg mol}^{-1}$).
All India 2014
42. An aqueous solution of sodium chloride freezes below 273 K . Explain the lowering in freezing point of water with the help of a suitable diagram.
Delhi 2013C
43. 18 g glucose, $C_6H_{12}O_6$ (molar mass = 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature, will this solution boil? (K_b for water = $0.52 \text{ K kg mol}^{-1}$, boiling point of pure water = 373.15 K).
Delhi 2013
44. Differentiate between positive deviation and negative deviation from Raoult's law, exhibited by binary solutions. (any two points)
Goa Board-2023
45. What happens when
 (a) a freshly prepared precipitate of Fe(OH)_3 is shaken with a small amount of FeCl_3 solution ?
 (b) persistent dialysis of a colloidal solution is carried out ?
 (c) an emulsion is centrifuged ?
UP Board-2018
46. 2 g of benzoic acid ($C_6H_5\text{COOH}$) is dissolved in 25g benzene shows a depression in freezing point equal of 1.64 K . What is the percentage association of benzoic acid if it forms double molecule in solution?
(Molar mass of benzoic acid = 122 g mol^{-1} , K_f for benzene = 4.9 kg mol^{-1})
NIOS Board-2023
47. A solution of sucrose (molar mass 342 g mol^{-1}) is prepared by dissolving 68.4 g in 1000 g of water find.
 (a) Boiling point of solution
 (b) Freezing point of solution.
(For water $K_b = 0.52 \text{ km}^{-1}$ and $k_f = 1.86 \text{ km}^{-1}$)
NIOS Board-2019
48. When 1.80 gm of non volatile compound is dissolved in 25 g of acetone, the solution boils at 56.86 C While pure acetone boils at 56.38 C under the same atmospheric pressure calculate the molar mass of the compound K_b for acetone is $1.72 \text{ K kg mol}^{-1}$
Punjab Board-2021
49. What is specific conductance of a solution? How it varies with dilution?
Punjab Board-2021
50. Elevation of boiling point is a colligative property.
 a) What are colligative properties?
 b) Elevation of boiling point (ΔT_b) is directly proportional' to molality (m) of solution. Thus $\Delta T_b = K_b m$, K_b is called the molal elevation constant. From the above relation derive an expression to obtain molar mass of the solute.
 c) The boiling point of benzene is 353.23 K . When 1.80 g of a non volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K . Calculate the molar mass of the solute. K_b for benzene is $2.53 \text{ K kg mol}^{-1}$
Kerala Board-2013
51. What are colligative properties? Give any one.
Andhra Pradesh Board-2020
52. A 5% solution (by mass)of cane sugar ($C_{12}H_{22}O_{11}$) in water has a freezing point of 271 K . Calculate the freezing point of 5% (by mass) solution of glucose ($C_6H_{12}O_6$) in water. Freezing point of pure water is 273.15 K .
Kerala Board-2019
53. How much electricity in coulombs is needed to discharge 0.5 mole of Cr^{3+} ions ? ($F = 96500 \text{ C}$)
Goa Board-2019
54. A solution containing 8.44 g of sucrose in 100 g of water has a vapour pressure 4.56 mm of Hg at 273K . If the vapour pressure of pure water is 4.58 mm of Hg at the same temperature, calculate the molecular weight of sucrose
ISC Board-2017
55. 18g of glucose, $C_6H_{12}O_6$, is dissolved in 1 kg of water in a sauce pan. At what temperature will water boil at 1.013 bar ? (K_b for water is $0.52 \text{ K kg mol}^{-1}$, boiling point of water = 373.15 K)
Kerala Board-2022
56. What do you mean by elevation in boiling point? Explain with the help of graph.
Chhattisgarh Board-2020
57. Draw a labeled diagram of dialysis method, for purification of colloidal solutions.
Rajasthan Board-2018
58. Which colligative property is preferred for the molar mass determination of macromolecules ?
Rajasthan Board-2014
59. What are colligative properties? Give one example of such properties.
Rajasthan Board-2010

60. (a) A solution is obtained by mixing 300g of 25% solution and 400g of 40% solution by mass. Calculate the mass percentage (w/w) of water in solution.
Assam Board-2020
61. (b) A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C . Determine the van't Hoff factor for trichloroacetic acid. (K_b for water = $0.512 \text{ K kg mol}^{-1}$).
Assam Board-2020
62. What is molal elevation constant? Derive its equation and give its unit.
Gujarat Board-2017
63. The boiling point of benzene is 353.23K when 1.80g of non-volatile solute was dissolved in 90g of benzene, the boiling point is raised to 354.11K . Calculate the molar mass of the solute. K_b for benzene is 2.53 Kkgmol^{-1} .
Nagaland Board-2020
64. Derive a relation between relative lowering of vapour pressure and mole fraction of the solute.
Meghalaya Board-2019
65. (a) What are colligative properties?
(b) Define osmosis and osmotic pressure.
Meghalaya Board-2021
66. Answer the following questions :
(a) The elevation in boiling point for 1 molal solution of non-volatile solute A is 3K and the depression in freezing point for 2 molal solution of A in the same solvent is 6K . What is the ratio of K_b and K_f ?
(b) A gaseous mixture of two substance A and B, under a total pressure of 0.8 atm is in equilibrium with an ideal liquid solution. If the mole fraction of substance A is 0.5 in the vapour phase and 0.2 in the liquid phase, then calculate the vapour pressure of pure liquid A.
Assam Board-2023
67. (a) 45g of ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) is mixed with 600g of water. Calculate (a) the freezing point depression and (b) the freezing point of the solution:
Nagaland Board-2021
68. Ethylene glycol (molar mass = 62 gmol^{-1}) is used as an antifreeze for water to be used in car radiators in cold places. How much ethylene glycol should be added to 1 kg of water to prevent it from freezing at 10°C ? [K_f for water = $1.86 \text{ K Kg mol}^{-1}$].
Nagaland Board-2018
69. (a) Calculate the amount of sodium chloride (electrolyte) which must be added to one kilogram of water so that the freezing point is depressed by 3K . Given K_f for water = $1.86 \text{ K kg mol}^{-1}$.
Nagaland Board-2017
70. A solution containing 4.2g of an organic compound in 50 g of acetone shows an elevation of boiling point by 1.8K . Determine the molar mass of the organic compound. K_b of acetone = 1.71 Kkgmol^{-1} .
Nagaland Board-2017
- 71.(a) The freezing point of 0.1 molal solution of CH_3COOH in benzene is 0.256K ($K_f = 5.12 \text{ Km}^{-1}$). What conclusion will you draw about molecular state of CH_3COOH in C_6H_6 ?
(b) A solution containing 18 g of a non-volatile solute in 200 g of H_2O freezes at 272.07 K . Find the molecular mass of the solute. ($K_f = 1.86 \text{ K m}^{-1}$)
Meghalaya Board-2018

Section-D : Case Based Study

1. Calculate the depression in the freezing point of water when 10 g of Calculate the depression in the freezing point of water when 10 g of $\text{CH}_3\text{CH}_2\text{CHClCOOH}$ is added to 250 g of water.
 $K_a = 1.4 \times 10^{-3}$, $K_f = 1.86 \text{ K kg mol}^{-1}$
[Atomic mass : H = 1, C = 12, O = 16, Cl = 35.5]
Gujarat Board 2023 (March)
2. 2g of benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) dissolved in 25g of benzene shows a depression in freezing point equal to 1.62K molal depression constant for benzene is 4.9K kg mol^{-1} . What is the percentage association of acid if it forms dimer in solution? (Molecular mass of benzoic acid is 122 gmol^{-1})
Gujarat Board-2022 (July)
- 3.(a) The concentration of the solution of the solution of glucose in water is 10% (w/w). If the density of this solution is 1.20 g mL^{-1} , then calculate –
(i) Molality
(ii) Molarity
(iii) Mole fraction of each component in solution
UP Board 2023
4. Assertion: True solution shows scattering of light.
Reason: In true solution, size of solute particles is much smaller than the wavelength of light used.
(a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.
(b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.
(c) Assertion is a correct statement, but Reason is a wrong statement.
(d) Assertion is a wrong statement, but Reason is a correct statement.
CBSE-2021

5. Assertion: Lyophilic sols are more stable than Lyophobic sols.

Reason: Lyophilic sols are highly solvated in the solution.

- (a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.
- (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.
- (c) Assertion is a correct statement, but Reason is a wrong statement.
- (d) Assertion is a wrong statement, but Reason is a correct statement.

CBSE-2021

6. Assertion: Colloidal solutions are purified by dialysis.

Reason: Colloidal particles pass through a suitable membrane in dialysis.

- (a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.
- (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.
- (c) Assertion is a correct statement, but Reason is a wrong statement.
- (d) Assertion is a wrong statement, but Reason is a correct statement.

CBSE-2021

7. Assertion: A positively charged sol is obtained when KI is added to AgNO_3 .

Reason: This is due to preferential adsorption of Ag^+ ions.

- (a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.
- (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.
- (c) Assertion is a correct statement, but Reason is a wrong statement.
- (d) Assertion is a wrong statement, but Reason is a correct statement.

CBSE-2021

8. Assertion: Colloidal solution shows Brownian Movement.

Reason: Colloid is not a substance but a state of substance.

- (a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.
- (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.
- (c) Assertion is a correct statement, but Reason is a wrong statement.
- (d) Assertion is a wrong statement, but Reason is a correct statement.

CBSE-2021

Section-E : Long Answer

1. (a) When 19.5 g of $\text{F}-\text{CH}_2-\text{COOH}$ (Molar mass = 78 g mol⁻¹) is dissolved in 500 g of water, the depression in freezing point is observed to be 1°C. Calculate the degree of dissociation of $\text{F}-\text{CH}_2-\text{COOH}$. [Given : K_f for water = 1.86 K kg mol⁻¹]
- (b) Give reasons :
- (i) 0.1 M KCl has higher boiling point than 0.1 M Glucose.
 - (ii) Meat is preserved for a longer time by salting.

CBSE-2020

2. A 10% solution (by mass) of sucrose in water has a freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water if the freezing point of pure water is 273.15 K. (Given molar mass of sucrose = 342 g mol⁻¹ and molar mass of glucose = 180 g mol⁻¹)

Delhi 2017; All India 2017

3. State Henry's law. At the same temperature, CO_2 gas is more soluble in water than O_2 gas. Which one of them will have higher value of K_H ?

Assam Board-2022

4. (a) Calculate the molality of 2.5 g of ethanoic acid (CH_3COOH) in 75 g of benzene.
- (b) The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point raised to 354.11 K. Calculate the molar mass of the solute. K_b for benzene is 2.53 K kg mol⁻¹.

NIOS Board-2018

5. a) 31 g of an unknown molecular material is dissolved in 500 g of water. The resulting solution freezes at 271.14 K. Calculate the molar mass of the material. Given: K_f for water = 1.86 K kg gmol⁻¹ T_f of water = 273 K.
- b) What is reverse osmosis? Mention its use.

Karnataka Board-2019

6. a) The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile, non-ionisable solute was dissolved in 90 g of benzene, the boiling point raised to 354.11 K. Calculate molar mass of the solute. [K_b for benzene = 2.53 K Kg mol⁻¹]
- b) Define:

- i) Molality of a solution.
- ii) Isotonic solutions.

Karnataka Board-2018

7. a) 1.0g of a non-electrolyte solute dissolved in 50g of benzene lowered the freezing point of benzene by 0.4K. Find the molar mass of the solute. [Given: Freezing point depression constant of benzene = 5.12 K kg mol⁻¹].
- b) How solubility of a gas in liquid varies with i) Temperature and ii) Pressure?

Karnataka Board-2017

8. a) 5.8 g of a non volatile solute was dissolved in 100 g of carbon disulphide (CS_2). The vapour pressure of the solution was found to be 190 mm of Hg. Calculate the molar mass of the solute given the vapour pressure of pure CS_2 is 195 mm of Hg.
 [Molar mass of CS_2 = 76 g mol $^{-1}$].
 b) Mention any two difference between Ideal and non-Ideal solutions.
- Karnataka Board-2016
9. a) A solution containing 18g of non-volatile non-electrolyte solute is dissolved in 200g of water freezes at 272.07 K. Calculate the molecular mass of solute.
 Given $K_f = 1.86\text{kg/mol}$ and freezing point of water = 273 K
 b) Define isotonic solution, What happens when the blood cell is dipped in a solution containing more than normal saline concentration?
 3 + 2
- Karnataka Board-2015
10. a) On dissolving 2.34g of solute in 40g of benzene, the boiling point of solution was higher than that of benzene by 0.81K. K_b value for benzene is 2.53K kg mol^{-1} . Calculate the molar mass of the solute.
 b) State Henry's law. Write its mathematical form.
 3 + 2
- Karnataka Board-2014
11. Draw a graph depicting the deviation from Raoult's law exhibited by a solution prepared by mixing ethanol and acetone.
 Calculate the molar mass of a non volatile solute 1.8 grams of which have been dissolved in 25 grams of acetone and the solution boils at 56.86°C. Pure acetone boils at 56.38°C. The molal elevation constant for acetone is 1.72 k kg mol $^{-1}$.
- Goa Board-2018
12. What are colligative properties? Name the various colligative properties? Derive a relation between relative lowering in vapour pressure and mole fraction of the solute?
- J&K Board-2019
13. (i) What are colligative properties?
 (ii) 400 cm 3 of an aqueous solution of a protein contain 1.26 g of the protein. The osmotic pressure of such solution at 300K is found to be 2.57×10^{-4} atm. Calculate molar mass of protein ($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)
- Kerala Board-2021
14. Draw a neat labelled diagram to show the elevation in boiling point of a solvent when a non-volatile solute is added to it.
 The vapour pressure of a 5% aqueous solution, by mass, of a non-volatile organic substance at 373 K is 745 mm of Hg. Calculate the molar mass of the solute.
 (Given vapour pressure of water at 373 K is 760 mm Hg.)
- Goa Board-2019
15. The existence of charge on colloidal particles is confirmed by electrophoresis experiment.
 (a) What is meant by electrophoresis?
 (b) In the coagulation of a negative sol, the coagulating power is in the order $\text{Al}^{3+} > \text{Ba}^{2+} > \text{Na}^+$. Name and state the rule behind this.
- Kerala Board-2020
16. For ethanol-acetone mixture solute-solvent interaction is weaker than solute-solute and solvent-solvent interaction.
 (a) Does this solution obey Raoult's law?
 (b) Give the vapour pressure-mole fraction graph for this solution.
- Kerala Board-2020
17. What is relative lowering in vapour pressure and show that it is a Colligative Property?
- Haryana Board -2016
18. What is elevation in boiling point and show that it is a Colligative property ?
- Haryana Board -2016
19. Define elevation in B.P. How can you calculate the molecular mass of a non-volatile solute with it?
- J & K board-2023
20. Define Osmotic Pressure. How is it determined by Berkeley-Hartley method?
- J & K board-2023
21. What are colligative properties ? Derive the relationship between the elevation in boiling point and molecular mass of a non-volatile solute in solution.
- J&K Board-2020
22. Define molarity and molality. Calculate molality of 2.5 g of ethanoic acid (CH_3COOH) in 75 g of Benzene.
- J&K Board-2020
23. The boiling point of benzene is 353.23 K. When 1.80 g of a nonvolatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. (K_b for benzene is $2.53 \text{ K kg mol}^{-1}$).
- Meghalaya Board-2019

E. Vapour Pressure of Liquid Solutions

Section-A : Multiple Choice Questions

1. 1.00 g of a non electrolyte solute dissolved in 50g of benzene lowered the freezing point of benzene by 0.40. The freezing point depression constant of benzene is $5.12 \text{ K kg mol}^{-1}$. Find the molar mass of the solute.
 (a) 280 g mol $^{-1}$ (b) 356 g mol $^{-1}$
 (c) 562 g mol $^{-1}$ (d) 256 g mol $^{-1}$

Gujarat Board-2021

Ans. (d)

2. The value of Henry's constant :
 (a) Increases with increase in temp
 (b) decreases with increase in temp
 (c) remains constant
 (d) first increases then decreases

Punjab Board-2021

Ans. (a)

3. Correct expression for elevation in boiling point is:
 (a) $\Delta T_b = K_b \cdot m$ (b) $\Delta T_f = K_f \cdot m$
 (c) $\pi = CRT$ (d) None of these

Haryana Board-2017

Ans. (a)

4. What will be boiling point, (in K) of 0.1 mol aqueous solution of urea? ($K_b = 3.2 \text{ K kg mole}^{-1}$)
 (a) 373.32 (b) 100.32
 (c) 0.32 (d) 405.2

Gujarat Board-2018

Ans. (a)

Section-B : Very Short Answer

1. State Henry's law. Calculate the solubility of CO_2 in water at 298 K under 760 mm Hg.
 (K_H for CO_2 in water at 298 K is $1.25 \times 10^6 \text{ mm Hg}$)

CBSE-2020

2. Identify which liquid will have a higher vapour pressure at 90°C if the boiling points of two liquids A and B are 140°C and 180°C, respectively.

CBSE-2020

3. State Henry's law and write its two applications.

CBSE-2019

4. Calculate the amount of CaCl_2 (molar mass 111 g mol^{-1}) which must be added to 500 g of water to lower its freezing point by 2 K assuming CaCl_2 is completely dissociated. K_f for water = 1.86 K kg mol^{-1}

CBSE-2019

5. 0.5 g of a non-volatile solute is dissolved in 100 g of ethyl acetate at 20°C. The vapour pressure of the solution and pure ethyl acetate are 72.0 torr and 72.8 torr, respectively at -28°C. Calculate molecular weight of the solute.

ISC Board-2001

6. (i) The freezing point of nitrobenzene is 278.8 K. A 0.25 molal solution of a substance (molecular weight : 120) in nitrobenzene has a freezing point of 276.8 K. Calculate the molal depression constant of nitrobenzene.
 (ii) Calculate osmotic pressure of a solution containing 3.42 g of sucrose in 1 L of water at 400 K.

ISC Board-2002

7. What will be the vapour pressure of a solution containing 5 moles of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) in 1 kg of water, if the vapour pressure of pure water is 4.57 mm of Hg ? ($C = 12$, $H = 1$, $O = 16$)

ISC Board-2014

8. Which of the following solutions will have a lower vapour pressure and why ?
 (i) A 5% solution of cane sugar ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$).
 (ii) A 5 % solution of urea (NH_2CONH_2).
 (Relative atomic masses of H = 1, C = 12, O = 16, N = 14)

ISC Board-2009

9. Correct the given statement : "Freezing point of a solution is directly proportional to its molality."

ISC Board-2001

10. A 2 molal solution of sodium chloride in water causes an elevation in the boiling point of water by 1.88 K. What is the value of van't Hoff factor ? What does it signify ? ($K_b = 0.52 \text{ K kg mol}^{-1}$)

ISC Board-2014

11. Correct the given statement : "Addition of sodium chloride lowers the boiling point and freezing point of water".

ISC Board-2003

12. Correct the following statement by changing the underlined part of the sentence.
 Water boils below 100°C by the addition of NaCl.

ISC Board-2008

13. Define cryoscopic constant.

ISC Board-2013

14. What is the unit of molal depression constant ?

ISC Board-2014

15. The van't Hoff factor of acetic acid solution is than one and the value of normal colligative property is than the observed colligative property of this solution.

ISC Board-2014

16. Why the freezing point depression (ΔT_f) of 0.4 M NaCl solution is nearly twice than that of 0.4 M glucose solution ?

ISC Board-2017

17. What is the mass of a non-volatile solute (molar mass 60) that needs to be dissolved in 100 g of water in order to decrease the vapour pressure of water by 25% ? What will be the molality of the solution?

ISC Board-2010

18. A solution is prepared by dissolving 2.0 g of sucrose and 2.0g of urea in 100 g of water at 298 K. Calculate the vapour pressure of the solution, if the vapour pressure of pure water at 298 K is 23.56 torr. (Molecular weight of urea = 60 and sucrose = 342)

ISC Board-2006

19. How is the vapour pressure of a solvent affected when a non-volatile solute is dissolved in it?
Delhi 2014C
20. State how the vapour pressure of a solvent is affected when a non-volatile solute is dissolved in it?
Foreign 2008
21. Some liquids on mixing form azeotropes. What are azeotropes?
Delhi 2014
22. Define the term azeotrope.
All India 2013
23. What will be the impact on K_f when the molality of a solution is doubled?
Assam Board-2022
24. The boiling point of benzene is 353.2 K. When 1.8 g of a non-volatile solute was dissolved in 90 g benzene the boiling point was raised to 354.1 K. Calculate the molecular mass of the solute. (K_b of benzene = 2.53 K kg mol⁻¹)
Odisha Board-2020
25. Why does vapour pressure of a liquid decrease when a non - volatile solute is added into it?
Manipur Board-2017
26. The vapour pressure of 2.1% of an aqueous solution pf a non electrolyte at 373 k is 755 mm calculate the molar mass of solute
Punjab Board-2021
27. The K_H values for Nitrogen gas (N_2) at 293K and 303K are 76.48 K bar and 88.84 K bar respectively.
Among these two given temperatures, at which temperature Nitrogen gas is more soluble in water
Karnataka Board-2020
28. At a given temperature, oxygen gas is more soluble in water than Nitrogen gas. Which one of them has higher value of K_H ?
Karnataka Board-2019
29. (i) Define :
 (a) Enthalpy of atomization
 (b) Enthalpy of vaporization
Maharashtra board-2018
30. Define minimum boiling azeotropes with example.
Kerala Board-2018
31. Why is Henry's law not applicable to dissolution of hydrogen chloride gas in water ?
Manipur Board-2019
32. Vapour pressure of water at 293 K is 17.535 mm Hg. Calculate the vapour pressure of the solution at 293 K when 25 g of glucose is dissolved in 450 g of water.
Andhra Pradesh Board-2021
33. The vapour pressure of pure benzene at a certain temperature is 0.850 bar . A non - volatile, non - electrolyte solid weighing 0.5 g when added to 39 gm of benzene (molar mass 78 g mol⁻¹), vapor pressure become 0.845 bar. What is the molar mass of the solid substance?
Kerala Board-2016
34. What happens to vapour pressure of water if a tablespoon of sugar is added to it ?
Rajasthan Board-2014
35. The boiling point of $CHCl_3$ is 61.5° C Calculate the molar heat of vaporization of the liquid, assuming ideal behaviour.
Tamilnadu Board, Sep.-2016
36. State Henry's law and write its important application.
Nagaland Board-2020

Section-C : Short Answer

1. Suggest a liquid that could be added to water so that the mixture boils below 100°C at the same pressure.
Manipur Board 2023
2. Vapour pressure of water at 293 K is 17.536 mm Hg. Calculate the vapour pressure of aqueous solution when 20 g of glucose (Molar mass = 180 g mol⁻¹) is dissolved in 500 g of water.
CBSE-2021
3. Vapour pressure of water at 293 K is 17.536 mm Hg. Calculate the vapour pressure of aqueous solution when 20g of glucose (Molar mass = 180g mol⁻¹) is dissolved in 500 g of water.
CBSE-2021
4. What is Relative Lowering of vapour pressure? How is it useful to determine the molar mass of a solute?
Telangana Board-2017
5. A 4% solution(w/w) of sucrose ($M = 342 \text{ g mol}^{-1}$) in water has a freezing point of 271.15 K. Calculate the freezing point of 5% glucose ($M = 180 \text{ g mol}^{-1}$) in water.
(Given : Freezing point of pure water = 273.15 K)
CBSE-2019
6. (a) 1·0 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0·40 K. The freezing point depression constant of benzene is 5·12 K kg mol⁻¹. Find the molar mass of the solute.
 (b) What is the significance of Henry's law constant, K_H ?
 (c) What leads to anoxia ?
CBSE-2019
7. At 25°C, the saturated vapour pressure of water is 3.165 k Pa (23.75 mm Hg). Find the saturated vapour pressure of a 5% aqueous solution of urea (carbamide) at the same temperature. (molar mass of urea = 60.05 g mol⁻¹).
Foreign 2012
8. Define azeotropes. What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.
Foreign 2015

9. Define azeotropes. What type of azeotrope is formed by position deviation from Raoult's law? Give an example.
- Delhi 2015
10. Henry's law constant for CO_2 dissolved in water is $1.67 \times 10^8 \text{ Pa}$ at 298 K . Calculate the quantity of CO_2 in 1 L of soda water when packed under 2.5 atm CO_2 pressure at 298 K .
- HOTS; Delhi 2008C
11. If N_2 gas is bubbled through water at 293 K , how many millimoles of N_2 gas would dissolve in 1 L of water? Assume that N_2 exerts a partial pressure of 0.987 bar . Given that Henry's law constant for N_2 at 293 K is 76.48 K bar .
- All India 2012C
12. State Henry's law. Why do gases nearly always tend to be less soluble in liquids as the temperature is raised?
- Assam Board-2022
13. Vapour pressure of water at 293K is 17.535 mm Hg . Calculate the vapour pressure of water at 293K when 25g of glucose is dissolved in 450g of water.
- Uttarakhand Board-2020
14. Vapour pressure of water at 293 K is 17.535 mmHg . Calculate the vapour pressure of the solution at 293 K when 25 g of glucose is dissolved in 450 g of water ?
- Andhra Pradesh Board-2019
15. (a) 18 g of glucose (molar mass = 180 g mol^{-1}) is dissolved in 1000g of water in sauce pan. At what temperature will this solution boil ?
 $(K_b \text{ for water} = 0.52 \text{ K Kg mol}^{-1}, \text{boiling point of pure water} = 373.15 \text{ K})$
- (b) State and explain briefly Henry's law.
- Punjab Board-2019
16. (a) What is Henry's law? What is relationship between partial pressure and mole fraction?
- (b) Calculate the vapour pressure lowering caused by the addition of 50 g sucrose (Molecular mass = 342) to 500 g of water if the vapour pressure of pure water 25°C is 23.8 mm Hg .
- NIOS Board-2023
17. Calculate the mass of a non-volatile (Molar-mass 40 g mol^{-1}) which should be dissolved in 114 g octane to reduce its vapour pressure to 80% .
- Haryana Board-2021
18. a) On dissolving 2.34g of solute in 40 g of benzene, the boiling point of solution was higher than that of benzene by 0.81 K . K_b value for benzene is $2.53 \text{ K kg mol}^{-1}$ Calculate the molar mass of the solute.
b) i) State Henry's law.
ii) How solubility of a gas in liquid changes with increase in temperature?
- Karnataka Board-2019
19. Mixture of two liquids A and B form an ideal solution. Draw the vapour pressure-composition curve for this solution.
- Kerala Board-2021
20. Mixing acetone and chloroform occurs with reduction in volume. Name the type of deviation from Raoult's law shown by the above mixture and state whether the process is endothermic or exothermic.
- Goa Board-2019
21. Why the freezing point depression (ΔT_f) of 0.4M NaCl solution is nearly twice than that of 0.4M glucose solution?
- ISC Board-2017
22. State Raoult's law.
- Assam Board-2014
23. What is meant by positive deviation from Raoult's law? Explain why this deviation is observed.
- Assam Board-2014
24. State Henry's law.
- Assam Board-2014
25. Define the terms:
(a) Freezing point
(b) Molal depression constant
- Haryana Board-2017
26. (a) State Henry's law. [1]
(b) Define the following terms–
(i) Mole fraction (ii) Molarity
- Uttarakhand Board-2019
27. Define the following:
(i) Henry's Law
(ii) Raoult's Law
- Haryana Board-2018
28. Will the elevation in boiling point be same if 0.1 mole of sodium chloride or 0.1 mole of sugar is dissolved in 1 L of water?
- Rajasthan Board-2014
29. Write two uses of Henry's law.
- Rajasthan Board-2011
30. State and prove Raoult's law for non-volatile solute in volatile solvent. Also give any two limitations of Raoult's law.
- Gujarat Board-2018
31. (b) Urea $[(\text{NH}_2)_2\text{CO}]$ forms an ideal solution in water. Calculate the vapour pressure of an aqueous solution containing 5% by mass of urea at 298 K . At 298K , vapour pressure water is 23.75 mm Hg .
- Assam Board-2015
32. A solution of sucrose (molecular mass 342 u) is prepared by dissolving 6.84 g in 100 g of water at 298 K
(i) Calculate the boiling point of the solution. ($K_b \text{ for water, } 0.52 \text{ kg mol}^{-1}$).
(ii) calculate the freezing point of the solution ($k_f \text{ for water, } 1.86 \text{ k kg mol}^{-1}$)
(iii) Calculate the osmotic pressure of the solution at 298 K (Density of water at $298\text{K} = 1 \text{ g mL}^{-1}$)
- Assam Board-2012

33. On dissolving 4gm urea in 100 gm water, 1.24°C depression in freezing point of the solution is obtained. Calculate molecular mass of urea. ($K_f = 1.86 \text{ K mol}^{-1}$)
- MP Board-2018
34. (a) Define the following:
 (i) Henry's law
 (ii) Normality
 (b) If 2 gram NaOH in 250 ml solution, then determine the normality of the solution.
- MP Board-2014
35. Vapour pressure of water at 293K is 17.535 mmHg. Calculate the vapour pressure of water at 293K, when 25g of glucose is dissolved in 450g of water.
- Nagaland Board-2020
36. What is meant by negative deviation from Raoult's law? What type of non-ideal solution is formed when ethanol is mixed with water?
- Assam Board-2023
37. How is nitric acid prepared by Ostwald's process? Give the reactions involved in it.
- Nagaland Board-2017

Section-D : Case Based Study

1. Vapour pressure of Chloroform (CHCl_3) and dichloromethane (CH_2Cl_2) at 298 K are 200 mm Hg and 415 mm Hg respectively
 i) Calculate the vapour pressure of the solution prepared by mixing 50g of CHCl_3 and 30 g of CH_2Cl_2 at 298 K.
 ii) Calculate mole fractions each component in vapour phase [Atomic mass : H = 1, C = 12 Cl = 35.5]

Gujarat Board 2023 (March)

Section-E : Long Answer

1. The vapour pressure of pure liquids A and B are 450 and 700 mm of Hg respectively at 350K. find out the composition of the liquid mixture if total vapour pressure is 600 mm of Hg. Also, find the composition of the vapour phase.

All India 2013C

2. (i) 18 g of glucose $\text{C}_6\text{H}_{12}\text{O}_6$, is dissolved in 1kg of water in a saucepan. At what temperature will the solution boil at 1.013 bar? K_b for water is $0.52 \text{ K kg mol}^{-1}$. [C = 12, H = 1, O = 16 g mol $^{-1}$].

Gujarat Board-2021

3. (a) Why is the vapour pressure of a solution containing a non-volatile solute always less than that of the pure solvent ?
 (b) Calculate the boiling point of a solution containing 0.456 g of camphor (molar mass = 152 g mol^{-1}) dissolved in 31.4 of acetone. [Given : Boiling point of pure acetone = 392.3 K , K_b of acetone = $1.72 \text{ K kg mol}^{-1}$]

NIOS Board-2019

4. (a) 1 g of a non-volatile solute was dissolved in 100 g of acetone (molecular mass = 58 u) at 298 K. The vapour pressure of the solution was found to be 192.5 mm Hg. Calculate the molecular mass of the solute. The vapour pressure of pure acetone at 298 K is 195 mm Hg.

- (b) Define:
 (i) Molality
 (ii) Molarity

NIOS Board-2011

5. (i) what is the vapour pressure of pure water of 100°C temperate ?
 (ii) 12 gm of a solid solute is dissolved in 90 gm pure water. Vapour pressure of the resulting solution is 750 mm Hg at 100°C temperature. Calculate molecular mass of the solute. [Solute does not undergo any dissociation or association in its aqueous solution.]

West Bengal Board-2019

6. State Henry's law. Calculate the mass of a non-volatile solute (molar mass 40 g mol^{-1}) which should be dissolved in 114 g of octane to reduce its vapour pressure to 80%

Andhra Pradesh Board-2020

7. Find the degree of association (X) when 1.0 gm benzoic acid, dissolved in 25 gm benzene is having depression in freezing point 0.81 K. The molal depression constant for solvent is $4.9 \text{ K kg mol}^{-1}$.

Gujarat Board-2019

8. a) 1.00 g of a non-electrolyte solute is dissolved in 50 g of benzene lowers the freezing point of benzene by 0.4K . The freezing point depression constant for benzene is $5.12 \text{ K Kg mol}^{-1}$. Find the molar mass of the solute.
 b) State Henry's law. Write its mathematical form.

Karnataka Board-2020

9. Vapour pressure of water at 293 K is 17.535 mm Hg. Calculate the vapour pressure of water at 293 K when 25 g of glucose is dissolved in 450 g of water.

OR

Draw the structures of the following compounds :

Jharkhand Board-2019

10. Briefly discuss elevation in boiling point.

Haryana Board-2017

11. (d) Ethylene glycol is used as antifreeze in car radiator water. Calculate the minimum molal concentration of ethylene glycol solution that will protect the car radiator from freezing at -1.90°C ?

- (e) The partial pressure of carbon dioxide gas inside a bottle of a carbonated soft drink is 4 atm at 25°C . How many moles of CO_2 are dissolved in a 355 mL can ?

(The Henry's law constant for CO_2 dissolved in water is $3.30 \times 10^{-2} \text{ mol L}^{-1} \text{ atm}^{-1}$ at 25°C).

14. Ethylene glycol is used as an antifreeze agent. Calculate the amount of ethylene glycol to be added to 4 kg of water to prevent it from freezing at -6°C . (K_f for $\text{H}_2\text{O} = 1.85 \text{ K mol}^{-1} \text{ kg}$) ISC Board-2013
15. The depression in the freezing point of a sugar was found to be 0.402°C . Calculate pressure of the sugar solution at 27°C . ($K_f = 1.86 \text{ K kg mol}^{-1}$) ISC Board-2007
16. The molecular weights of sodium chloride and glucose are determined by the depression of freezing point method. Compared to their theoretical molecular weight, when determined by the above method? Justify your answer. ISC Board-2007
17. Equal weights of two substances X and Y are dissolved in equal volumes of water. The osmotic pressure of the solution containing Y is five times the osmotic pressure of the solution containing X. What is the molecular weight of X if that of Y is 60? ISC Board-2009
18. The molecular weight of sodium chloride determined by measuring the osmotic pressure of its aqueous solution is
 (a) double the theoretical value
 (b) same as the theoretical value
 (c) half the theoretical value
 (d) three times the theoretical value ISC Board-2009
19. The osmotic pressure of 0.25 M urea solution is 2.67 atm . What will be the osmotic pressure of a 0.25 M solution of potassium sulphate? ISC Board-2010
20. The elevation in boiling point produced by dilute equimolar solution of three substances are in the order
 $A > \text{glucose} > B$. Suggest a reason for this observation. ISC Board-2010
21. Out of the following solutions, the one having the highest boiling point will be
 (a) 0.1 M NaCl
 (b) 0.1 M BaCl_2
 (c) 0.1 M KNO_3
 (d) $0.1 \text{ M K}_4[\text{Fe}(\text{CN})_6]$. ISC Board-2011
22. 0.1M urea solution shows less depression in freezing point than 0.1 M MgCl_2 solution. Explain. ISC Board-2011
23. A solution X is prepared by dissolving 3 moles of glucose in one litre of water and a solution Y is prepared by dissolving 1.5 moles of sodium chloride in one litre of water. Will the osmotic pressure of X be higher, lower or equal to that of Y?
 Give a reason for your answer. ISC Board-2012
24. Define Raoult's law for the elevation in boiling point of a solution. ISC Board-2014
25. Solutions which strictly obey law are called solutions. ISC Board-2012
26. Define osmotic pressure of a solution. How is the osmotic pressure related to the concentration of a solute in a solution? Delhi 2015C
27. Define the term osmotic pressure. All India 2013; Delhi 2010C, 2009C
28. State Raoult's law. Foreign 2012
29. Define Faoult's law in its general form in reference to solutions. Delhi 2011; All India 2011; Foreign 2011
30. State Raoult's law for a solution of volatile liquids. Delhi 2010C; Foreign 2009C
31. Define osmotic pressure and derive van't Hoff equation for dilute solutions. State the condition leading to reverse osmosis. Manipur Board-2018
32. Define the following :
 (i) Graham's law of diffusion
 (ii) Critical temperature of a gas NIOS Board-2019
33. Calculate the ratio of rates of diffusion of hydrogen and oxygen gases under similar conditions of temperature and pressure.
 [Atomic mass : H = 1.0 u , O = 16.0 u] NIOS Board-2022
34. 10 mL of liquid A is mixed with 10 mL of liquid B, the volume of the resultant solution is 19.9 mL . What type of deviation is expected from Raoult's law? Karnataka Board-2020
35. Define Dalton's law of partial pressure. NIOS Board-2014
36. State Raoult's law of a binary solution for two volatile liquid components. Karnataka Board-2017
37. Derive an expression to calculate molar mass of non volatile solute by osmotic pressure measurement. Maharashtra board-2022
38. What is reverse osmosis? Write any one of its applications. Kerala Board-2019
39. Two solutions having same osmotic pressure at a given temperature are called — Kerala Board-2022
40. Draw structural formula of 3-chlorohexanoic acid. Chhattisgarh Board-2020
41. Define Osmotic Pressure. Andhra Pradesh Board-2018

42. State Raoult's Law.
The vapour pressure of pure benzene at a certain temperature is 0.850 bar. A non-volatile, non-electrolyte solid weighing 0.5g when added to 39.0 g of benzene (molar mass 78 g mol^{-1}). Vapour pressure of the solution, then is 0.845 bar. What is the molar mass of the solid substance ?
Andhra Pradesh Board-2016
43. Define osmotic pressure.
Andhra Pradesh Board-2016
44. Differentiate between positive deviation and negative deviation from Raoult's law, exhibited by binary solutions. (any two points)
Goa Board-2019
45. Write definition of Osmosis.
Rajasthan Board-2020
46. Define the following terms:
(iv) Isotonic solutions
Assam Board-2020
47. Define the following:
(i) Osmotic pressure
(ii) Van't Hoff factor
(iii) Molal freezing depression constant
MP Board-2018
- Section-C : Short Answer**
1. 1.25 g protein is present in 300 mL aqueous solution of a protein. The osmotic pressure of such a solution at 300 K is found to be 2.50×10^{-3} bar. Calculate the molar mass of protein. ($R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$)
Rajasthan Board 2022
2. Write definition of osmosis. Write name of method used in desalination of sea water.
Rajasthan Board 2023
3. What type of deviation from Raoult's law is observed by mixing chloroform and acetone? Why is a decrease in vapour pressure observed on mixing chloroform and acetone?
CBSE-2021
4. A solution containing 1.9 g per 100 mL of KCl ($M = 74.5 \text{ g mol}^{-1}$) is isotonic with a solution containing 3 g per 100 mL of urea ($M = 60 \text{ g mol}^{-1}$). Calculate the degree of dissociation of KCl solution. Assume that both the solutions have same temperature.
CBSE-2019
5. (a) A 5% solution (by mass) of cane sugar in water has a freezing point of 271 K. Calculate the freezing point of 5% solution (by mass) of glucose in water. The freezing point of pure water is 273.15 K.
(b) Why is osmotic pressure of 1 M KCl higher than 1 M urea solution ?
(c) What type of liquids form ideal solutions ?
CBSE-2019
6. At 300 K, 30 g of glucose present in a litre of its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of a glucose solution is 1.52 bar at the same temperature, what would be its concentration ?
CBSE-2019
7. Define osmotic pressure. Arrange the following in increasing order of osmotic pressure and give reasons in support of your answer.
(i) 34.2 g per litre of sucrose (Molecular weight = 342).
(ii) 90.0 g per litre of glucose (Molecular weight = 180).
(iii) 5.85 g per litre of sodium chloride (Molecular weight = 58.5).
ISC Board-2004
8. (i) A 10% aqueous solution of cane sugar (mol.wt. = 342) is isotonic with 1.754% aqueous solution of urea. Find the molecular mass of urea.
(ii) The molecular weight of an organic compound is 58 g mol^{-1} . What will be the boiling point of a solution containing 48 g of the solute in 1200 g of water ? [K_b for water = $0.513^\circ\text{C kg mol}^{-1}$; boiling point of water = 100°C]
(iii) What will be the value of van't Hoff factor (i) of benzoic acid, if it dimerises in aqueous solution ? How will the experimental molecular weight vary as compared to the normal molecular weight ?
ISC Board-2016
9. At 300 K, 36 g of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$ present per litre in its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of another glucose solution is 1.52 bar at the same temperature, calculate the concentration of the other solution.
HOTS; All India 2011C
10. Calculate the boiling point of one molar aqueous solution. Density of KBr solution is 1.06 g mL^{-1} (K_b for $\text{H}_2\text{O} = 0.52 \text{ K kg mol}^{-1}$, atomic mass of K = 39, Br = 80).
HOTS; All India 2011C
11. A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C . Assuming the gene fragment is non-electrolyte, determine its molar mass.
Delhi 2011; all India 2011
12. Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2 L of water at 25°C , assuming that it is completely dissociated. ($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$, molar mass of $\text{K}_2\text{SO}_4 = 174 \text{ g mol}^{-1}$)
Delhi 2013
13. Define the term osmotic pressure. Describe how the molecular mass of a substance can be determined by a method based on measurement of osmotic pressure?
Delhi 2008; all India 2008; Foreign 2008
14. Define the terms osmosis and osmotic pressure. What is the advantage of using osmotic pressure as compared to other colligative properties for the determination of molar masses of solutes in solutions?
All India 2010

15. Explain why a solution of chloroform and acetone shows negative deviation from Raoult's law?
HOTS; Delhi 2011C
16. State Raoult's law for solutions of volatile liquids. Taking suitable examples, explain the meaning of positive and negative deviations from Raoult's law.
Delhi 2008; Foreign 2008; All India 2008
17. State Raoult's law for a solution containing volatile components. How does Raoult's law become a special case of Henry's law?
Delhi-2014, All India 2013
18. What is meant by negative deviation from Raoult's law? Give an example. What is the sign of $\Delta_{\text{mix}} H$ for negative deviation?
Foreign 2015
19. What is meant by positive deviation from Raoult's law? Give an example. What is the sign of $\Delta_{\text{mix}} H$ for positive deviation?
Delhi 2015
20. Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type.
All India 2011, 2010;
Delhi 2010; Foreign 2010
21. What is meant by negative deviation from Raoult's law? Draw a diagram to illustrate the relationship between vapour pressure and mole fraction of components in a solution to represent negative deviation.
All India 2008C
22. The solubility of pure nitrogen gas at 25°C and 1 atm is $6.8 \times 10^{-4} \text{ mol L}^{-1}$. What is the concentration of nitrogen dissolved in water under atmospheric conditions? The partial pressure of nitrogen gas in the atmosphere is 0.78 atm.
HOTS; Delhi 2008
23. The partial pressure of ethane over a saturated solution containing $6.56 \times 10^{-2} \text{ g}$ of ethane is 1 bar. If the solution contains $5.0 \times 10^{-2} \text{ g}$ of ethane, then what will be the partial pressure of the gas?
Delhi 2013; All India 2012C
24. (b) The Osmotic pressure of a solution, containing 45gm of sucrose dissolved per liter of solution at 20°C , is 3.2. Calculate the value of constant R. (molecular weight of sucrose = 342)
Uttarakhand Board-2020
25. Give reasons for the following :
 (a) Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.
 (b) Aquatic animals are more comfortable in cold water than in warm water.
 (c) Elevation of boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution.
26. What is Raoult's law? The vapour pressure of a 5% aqueous solution of a non - volatile organic substance at 373K is 745 mm. Calculate the molar mass of the solute.
Manipur Board-2017
27. What is meant by positive deviation from Raoult's law? Give one example of such a solution.
NIOS Board-2018
28. X and Y are two completely miscible liquids and the intermolecular forces vary as $Y-Y < X-X < X-Y$.
Explain-
 (a) Which one of the two liquids will boil at a higher temperature;
 (b) When the two liquids are mixed, what type of deviations would the solution show from the Raoult's law.
NIOS Board-2013
29. KBr undergoes 80% dissociation in its 0.5 (M) aqueous solution. Calculate osmotic pressure of the solution at 27°C temperature.
West Bengal Board-2019
30. (i) Prove that osmotic pressure is a colligative property.
 (ii) Calculate the molar concentration of urea solution if it exerts an osmotic pressure of 2.45 atmosphere at 300K . [$R = 0.0821 \text{ L atm mol}^{-1}\text{K}^{-1}$]
Punjab Board-2017
31. a) 300 cm^3 of aqueous solution of a protein contains 2.12 g of the protein, The osmotic pressure of such a solution at 300 K is found to be $3.89 \times 10^{-3} \text{ bar}$. Calculate the molar mass of the protein. ($R = 0.0823 \text{ L bar mol}^{-1}\text{K}^{-1}$)
 b) i) State Henry's law
 ii) Soda water bottles are sealed under high pressure.
Karnataka Board-2016
32. What is Raoult's law ? Explain its mathematical expression.
Chhattisgarh Board-2022
33. A solution contains 15g urea (molar mass = 60 g mol^{-1}) per liter of solution in water has the same osmotic pressure as a solution of glucose (molar mass = 180 g mol^{-1}) in water. Calculate the mass of glucose present in one liter of its solution.
Kerala Board-2018
34. Osmotic pressure is a colligative property.
 (a) What is osmotic pressure?
 (b) 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K . The freezing point depression constant of benzene is 5.12 K kg/mol . Find the molar mass of solute.
Kerala Board-2016

35. A 0.15 M aqueous solution of KCl exerts an osmotic pressure of 6.8 atm at 310 K. Calculate the degree of dissociation of KCl. ($R = 0.0821 \text{ Lit, atm K}^{-1} \text{mol}^{-1}$)
ISC Board-2017
36. What is osmotic pressure? Show that it is a colligative property.
Haryana Board-2017
37. Why is osmotic pressure considered to be a colligative property?
Haryana Board-2016
38. (a) State Kohlrausch's law. [1]
(b) Write short note on following—
(i) Strong Electrolyte (ii) Weak Electrolyte
Uttarakhand Board-2019
39. (a) Among the following which is not a colligative property?
(i) Osmotic pressure
(ii) Elevation of boiling point
(iii) Vapour pressure
(iv) Depression of freezing point
(b) (i) 200 cm³ of aqueous solution of a protein contains 1.26 g of protein. The osmotic pressure of solution at 300 K is found to be 8.3×10^{-2} bar. Calculate the molar mass of protein. ($R = 0.083 \text{ L bar K}^{-1} \text{mol}^{-1}$)
(c) (ii) What is the significance of Van't Hoff factor ?
Kerala Board-2015
40. State Raoult's law. The vapour pressure of pure Benzene at a certain temperature is 0.850 bar. A non-volatile, non-electrolyte solid weighing 0.5 g when added to 39.0 g of benzene (molar mass 78g mol⁻¹). Vapour pressure of the solution, then is 0.845 bar. What is the molar mass of the solid substance ?
Andhra Pradesh Board-2018
41. Calculate the osmotic pressure of 0.01 M solution of urea at 27°C temperature. ($R = 0.0821 \text{ L atm K}^{-1} \text{mol}^{-1}$)
Rajasthan Board-2020
42. 0.05M solution of $\text{K}_4[\text{Fe}(\text{CN})_6]$ at 300K is 92% dissociated. Calculate the osmotic pressure of the solution ($R=0.0821 \text{ atm. LK}^{-1} \text{mol}^{-1}$)
Rajasthan Board-2019
43. Write definition of osmotic pressure.
Rajasthan Board-2018
44. What is the difference between diffusion and osmosis? Give one example of each. Exhibit diffusion and osmosis through labelled diagrams.
Rajasthan Board-2010
45. (a) Mention a method used for desalination of sea water.
(b) Define the term 'osmotic pressure'. How osmotic pressure of a solution vary with temperature?
Assam Board-2016
46. Define the following :
(i) Azeotropic mixtures
(ii) Isotonic solution
(iii) Semipermeable membrane
MP Board-2018
47. Calculate osmotic pressure of the solution which contains 68.4 gram sucrose in 1000 ml of solution at 293 K. ($R = 0.082 \text{ litre atm. K}^{-1} \text{mol}^{-1}$).
MP Board-2018
48. Calculate the osmotic pressure of 5% solution of glucose at 25°C (Molecular weight of Glucose = 180 and $R = 0.0821 \text{ liter atm K}^{-1} \text{mol}^{-1}$)
MP Board-2013
49. What is reverse osmosis ? Mention one of its applications.
Meghalaya Board-2018

Section-E : Long Answer

1. (a) A solution contains 5.85 g NaCl (Molar mass = 58.5 g mol⁻¹) per litre of solution. It has an osmotic pressure of 4.75 atm at 27°C. Calculate the degree of dissociation of NaCl in this solution.
Given : $R = 0.082 \text{ L atm K}^{-1} \text{mol}^{-1}$
(b) State Henry's law. Why is air diluted with helium in the tanks used by scuba divers ?
CBSE-2020
2. (i) On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?
(ii) What happens when we place the blood cell in water (hypertonic solution)? Give reason.
All India 2015
3. (ii) 200 cm³ of aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300 k is found to be 2.57×10^{-3} bar. Calculate the molar mass of the protein.
Gujarat Board-2021
4. Define the following terms :
(a) Isotonic solution
(b) Osmosis
(c) Gold crystallises into face-centred cubic cells. The edge length of unit cell is 4.08×10^{-8} cm. Calculate the density of gold.
[Molar mass of gold = 197 g mol⁻¹]
Maharashtra board-2022
5. 200 cm³ of an aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300K is found to be 2.57×10^{-3} bar. Calculate the molar mass of the protein.
Assam Board-2014
6. Osmotic pressure of a solution is 0.0821 atm at a temperature of 400 k. Calculate the concentration of solution in mol/litre.
[$R = 0.0821 \text{ L atm K}^{-1} \text{mol}^{-1}$]
Rajasthan Board-2015

7. 0.2 L of aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300 K is found to be 2.57×10^{-3} bar. Calculate the molar mass of the protein. ($R = 0.083 \text{ L bar mol}^{-1}\text{K}^{-1}$).

Rajasthan Board-2013

8. Write Van't Hoff's laws of osmotic pressure, give its mathematic formula and derive a formula to find osmotic pressure.

Gujarat Board-2019

9. Define osmotic pressure. How can molar mass of a substance be determined from the measurement of osmotic pressure of a solution?

Assam Board-2013

10. What is osmotic pressure? Draw a labelled diagram of Barkeley- Hartley method of determination of osmotic pressure.

MP Board-2015

G. Ideal and non Ideal Solution

Section-A : Multiple Choice Questions

1. Which mixture shows negative deviation from Raoult's law?

- (a) ethanol and acetone
- (b) carbon disulphide and acetone
- (c) hexane and heptane
- (d) phenol and aniline

Gujarat Board 2023 (March)

Ans. (c)

2. A compound $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ undergoes complete dissociation in water. The Van't Hoff factor 'i' is:

- (a) 9
- (b) 6
- (c) 3
- (d) 4

Gujarat Board 2023 (July)

Ans. (c)

3. Which of the following is non-ideal solution?

- (a) Phenol + Aniline
- (b) Benzene + Touene
- (c) n-hexane + n-heptane
- (d) Bromo ethane + chloro ethane

Gujarat Borad-2022 (July)

Ans. (a)

4. The compound having highest value of Van't Hoff factor (i) for complete dissociation of solute in aqueous solution is-

- (a) KCl
- (b) NaCl
- (c) K_2SO_4
- (d) MgSO_4

Rajasthan Board 2022

Ans. (d)

5. How many ions are produced from the complex $[\text{Co}(\text{NH}_3)_5\text{Cl}] \text{Cl}_2$ in solution ?

- (a) 4
- (b) 2
- (c) 3
- (d) 5

CBSE-2020

Ans. (c)

6. Assertion (A) : Non-ideal solutions form azeotropic mixture.

Reason (R) : Maximum boiling azeotropes are formed by a solution showing negative deviation.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
- (b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
- (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
- (d) Assertion (A) is incorrect, but Reason (R) is correct statement.

CBSE-2020

Ans. (b)

7. What mass of NaCl must dissolved in 65.0g of water to lower the freezing point of water by $7.50 \text{ }^\circ\text{C}$? The freezing point depression constant (K_f) for water is $1.86 \text{ }^\circ\text{C/m}$. Assume Van't Hoff factor for NaCl is 1.87.
(Molar mass of $\text{NaCl} = 58.5 \text{ g mol}^{-1}$)

NIOS Board-2022

Ans. (0)

8. The Van't Hoff factor 'i' for a solution of acetic acid in benzene will be _____
- (a) greater than one
 - (b) less than one
 - (c) equal to one
 - (d) zero

Goa Board-2018

Ans. (b)

9. Which of the following is appropriate for the solution made by mixing acetone and carbondisulphide?

- (a) Negative deviation from Raoult's law
- (b) $\Delta H_{\text{mix}} < 0$
- (c) $\Delta V_{\text{mix}} > 0$
- (d) Obey Raoult's laws

Gujarat Board-2019

Ans. (c)

10. Which of the following is an example of Ideal solution?

- (a) Chloroform-Acetone
- (b) Water-Nitric Acid
- (c) Ethanol-Water
- (d) Benzene-Toluene

Gujarat Board-2020

Ans. (d)

11. K_B Value for $\text{Ar}_{(g)}$, $\text{CO}_{2(g)}$, $\text{HCHO}_{(g)}$ and CH_{2g} are 40 , 39 , 1.67 , 1.82×10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility.

- (a) $\text{HCHO} < \text{CH}_4 < \text{CO}_2 < \text{Ar}$
- (b) $\text{HCHO} < \text{CO}_2 < \text{CH}_4 < \text{Ar}$
- (c) $\text{Ar} < \text{CO}_2 < \text{CH}_4 < \text{HCHO}$
- (d) $\text{Ar} < \text{CH}_4 < \text{CO}_2 < \text{HCHO}$

Gujarat Board-2020

Ans. (c)

Section-B : Very Short Answer	
1. (a) What type of deviation from Raoult's law is shown by a mixture of ethanol and acetone? Give reason.	15. State Raoult's law. Telangana Board-2023
2. What are Ideal Solutions? Given one example	16. What is an ideal solution? NIOS Board-2015
3. The van't Hoff factor (i) of a solution is more than one. What does it indicate?	17. What is van't Hoff factor? How does it help in calculating degree of association? Odisha Board-2023
4. Explain the reason for exhibiting negative deviation from Raoult's law by the solution of chloroform and acetone.	18. Calculate the degree of dissociation of acetic acid in its 0.1 M solution. Given : $K_a = 1.8 \times 10^{-5}$ NIOS Board-2018
5. (a) On dissolving 3.46 g of non-volatile solute in 100 g of water, the boiling point of solution was raised to that of pure water by 0.12 K. Calculate the molar mass of non-volatile solute. (Given : K_b of water = 0.51 K Kg mol ⁻¹). (b) What type of deviation from Raoult's law is observed when equal volume of ethanol and acetone are mixed? Mention the reason for it.	19. What is the value of Van't Hoff factor (i) for K_2SO_4 ? Karnataka Board-2020
6. Give two properties that should be possessed by a solution to be an ideal solution	20. How does the volume change on mixing two volatile liquids to form an ideal solutions? Karnataka Board-2019
7. Predict the state of the solute in the solution in the following situations: (a) When 'i' is found to be more than one. (b) When 'i' is found to be less than one.	21. Van't Hoff's factor for a solution is less than one, what is the conclusion drawn from it? Karnataka Board-2018
8. Write the value of the van't Hoff factor for a dilute solution of potassium sulphate in water.	22. Under what conditions the van't Hoff factor is greater than one ? Punjab Board-2017
9. Write two differences between an Ideal solution and Non-ideal solution.	23. What are ideal solutions? Karnataka Board-2016
10. Define the term van't Hoff factor	24. Van't Hoff factor for a solution is more than one. What is the conclusion drawn from it? Karnataka Board-2017
11. Define the following terms. (i) Isotonic solutions (ii) van't Hoff factor	25. Define van't Hoff factor. What would be the value of van't Hoff factor for a dilute aqueous solution of Na_2SO_4 ? Manipur Board-2019
12. Define the following (i) Ideal solution (ii) Molarity (M)	26. The extent to which a solute is dissociated or associated can be expressed by 'Van't Hoff factor'. Substantiate the statement. Kerala Board-2016
13. Define ideal solution.	27. Define the following terms: (v) Ideal solution Assam Board-2020
14. Define an ideal solution and write one of its characteristics.	28. (a) What is an ideal solution? Assam Board-2015
	29. Tyndal effect is due to of light. J & K board-2023
	30. Vinegar is a dilute solution of J&K Board-2020
	31. Why do some non-ideal solutions show positive deviation from ideal behaviour? Give suitable diagram. Nagaland Board-2018

Section-C : Short Answer

1. What is an Ideal Solution?
Telangana Board-2017
2. Define Zoetrope. What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.
Gujarat Board 2023 (July)
3. Give three differences between ideal and non-ideal solutions.
MP Board 2020
4. A 0.561 m solution of unknown electrolyte depresses the freezing point of water by 2.93°C . What is van't Hoff factor for this electrolyte? The freezing point depression constant (K_f) for water is $1.86^{\circ}\text{C kg mol}^{-1}$.
Foreign 2011
5. 3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate the van't Hoff factor and predict the nature of solute (associated or dissociated).
(Given : Molar mass of benzoic acid = 122 g mol^{-1} , K_f for benzene = 4.9 K kg mol^{-1})
Delhi 2015
6. What is van't Hoff factor? What possible values can it have if the solute molecules undergo dissociation?
Delhi 2011C
7. A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point 100.18°C . Determine the van't Hoff factor for trichloroacetic acid.
(K_b for water = 0.512 K kg mol^{-1}).
Delhi 2012
8. (i) Gas (A) is more soluble in water than gas (B) at the same temperature. Which one of the two gases will have the higher value of K_H (Henry's constant) and why?
(ii) In non-ideal solution, what type of deviation shows the formation of maximum boiling azeotropes?
All India 2016
9. What is Raoult's Law? Given its two limitations.
Uttarakhand Board-2020
10. Write two differences between ideal and non-ideal solution.
(i) Calculate the molality of 1M concentrated solution of NaNO_3 , if density of solution = 1.25 g cm^{-3} .
Chhattisgarh Board-2023
11. (ii) Write any two differences between non-ideal solutions with positive and negative deviation.
(iii) Calculate normality of solution, containing 4 gm NaOH in 250 ml aqueous solution.
Chhattisgarh Board-2023
12. What are the characteristics of ideal solution?
Manipur Board-2017
13. What is azeotropic mixture ? Can it be considered as ideal solution ?
West Bengal Board-2019
14. Explain the following terms :
(a) Dialysis
(b) Tyndall effect.
Jharkhand Board-2019
15. Determine the freezing point of a solution containing 0.625 g of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) dissolved in 102.8 g of water. (Freezing point of water = 273 K, K_f for water = 1.87 K kg mol^{-1} , at. wt. C = 12, H = 1, O = 16)
ISC Board-2017
16. Name a method for desalination of sea water.
Assam Board-2014
17. What are azeotropes?
Assam Board-2014
18. State Kohlrausch law of independent migration of ions. How is the law used to determine the degree dissociation of a weak electrolyte ?
Manipur Board-2019
- 19.(i) Define ideal and non-ideal solutions. Give one example of each solution
(ii) NaCl solution freezes at lower temperature than water but boils at higher temperature. Explain.
Rajasthan Board-2011
20. State Henry's law.
At the same temperature, CO_2 gas is more soluble in water than O_2 gas. Which one of them will have higher value of K_H ?
Assam Board-2017
21. State Henry's law.
At the same temperature, hydrogen gas is more soluble in water than helium gas. Which one of them will have higher value of K_H ?
Assam Board-2015
22. (a) Give two difference between Ideal and non-Ideal solutions.
(b) Find out osmotic pressure of Glucose solutions of 5% sol. at 25°C temp while molecular mass of Glucose 180 and $R = 0.0821 \text{ Litre Atmosphere}$.
MP Board-2016

- | | | |
|--------------------------------|--|---|
| 23. | What is Raoult's law? Write any four differences between Ideal and nonideal solutions.

MP Board-2015 | (a) The observed and calculated molar mass of KCl is 38.75 g and 75.5 g per mol respectively. Calculate van't Hoff factor.

(b) The relative lowering of vapour pressure produced by dissolving 7.2 g of a substance in 100 g water is 0.00715. Calculate the molar mass of the substance.

NIOS Board-2023 |
| 24. | What is Raoult's law? How can molar mass of a non-volatile solute be determined with its help?

MP Board-2013 | 6. (a) Give any four characteristics of a solution showing positive deviation.
(b) Give any four characteristics of a solution showing negative deviation.

Haryana Board-2016 |
| 25. | Explain Tyndal effect.

J & K board-2023 | 7. State and prove Raoult's law for non-volatile solute.

Gujarat Board-2018 |
| 26.(a) | What will happen to the boiling point of a solution on mixing two miscible liquids showing negative deviation from Raoult's law? | 8. What is meant by positive deviations from Raoult's law? How is the sign of $\Delta_{\text{mix}}H$ related to positive deviations from Raoult's law?

Assam Board-2019 |
| (b) | Give two conditions necessary for a solution to be ideal.

Meghalaya Board-2019 | |
| 27. | (a) Why does non-ideal solutions show positive deviations and negative deviations from Raoult's law ?

Nagaland Board-2021 | |
| 28. | What is hypertonic solution and hypotonic solution ?

Nagaland Board-2021 | |
| Section-E : Long Answer | | |
| 1. | The observed and calculated molar mass of KCl is 38.75 g mol ⁻¹ and 75.5 g mol ⁻¹ respectively, calculate Vant-Hoff factor and degree of dissociation of KCl.

NIOS Board-2022 | 1. Which of the following aqueous solution has highest boiling point, under identical condition having concentration 0.03m?
(a) K ₄ [Fe(CN) ₆] (b) Na ₂ SO ₄
(c) Urea (d) NaCl

Gujarat Board-2019 |
| 2. | a) Explain, what are non-ideal solutions.
b) 2g of benzoic acid (molar mass = 122 g mol ⁻¹) when dissolved in 25g of benzene shows a depression in freezing point equal to 1.62 K. what is the percentage of association of the acid if it forms dimer in the solution. [K _f for benzene = 4.9 K kg mol ⁻¹]

NIOS Board-2021 | 2. The unit of ebullioscopic constant is:
(a) K kg mol ⁻¹ (b) mol kg K ⁻¹
(c) K mol kg ⁻¹ (d) None of the above

Haryana Board-2017 |
| 3. | (a) The observed and calculated molar mass of KCl is 38.75 g mol ⁻¹ and 75.5 g per mole respectively. Calculate the Van't-Hoff factor.

(b) The relative lowering of vapour pressure produced by dissolving 7.2 g of substance in 100 g of water is 0.00715. Calculate the molar mass of the substance.

NIOS Board-2021 | 3. The solubility of which solution decrease with increase in temperature?
(a) Aqueous solution of H ₂ SO ₄
(b) Aqueous solution of sugar
(c) Chlorine water
(d) Na-Hg Amalgam

Gujarat Board-2018 |
| 4. | (a) Define van't Hoff factor.
(b) Calculate the osmotic pressure of a solution prepared by dissolving 0.025g of K ₂ SO ₄ is completely dissociated.
[R = 0.0821 L atm K ⁻¹ mol ⁻¹ ; Molar mass of K ₂ SO ₄ = 174g mol ⁻¹]

NIOS Board-2014 | Ans. (c) |

H. Abnormal Molar Masses

Section-A : Multiple Choice Questions

1. Which of the following aqueous solution has highest boiling point, under identical condition having concentration 0.03m?

(a) $K_4[Fe(CN)_6]$ (b) Na_2SO_4
(c) Urea (d) $NaCl$

Gujarat Board-2019

Ans. (a)

- 2. The unit of ebullioscopic constant is:**

(a) K kg mol^{-1} (b) mol kg K^{-1}
(c) K mol kg^{-1} (d) None of the above

Haryana Board-2017

Ans. (a)

3. The solubility of which solution decrease with increase in temperature?

 - (a) Aqueous solution of H_2SO_4
 - (b) Aqueous solution of sugar
 - (c) Chlorine water
 - (d) Na-Hg Amalgam

1. Visha took two aqueous solutions - one containing 7.5 g of urea (Molar mass = 60 g/mol) and the other containing 42.75 g of substance Z in 100 g of water, respectively. It was observed that both the solutions froze at the same temperature. Calculate the molar mass of Z.

CBSE-2020

2. A solution was prepared by dissolving 5g of non-volatile solute in 95 g of water. It has a vapour pressure of 23.375 mm Hg at 298 K. Calculate the molar mass of the solute. [Vapour pressure of pure water at 298 K is 23.75 mm Hg]

CBSE-2020

3. Define the following terms:
 (i) Abnormal molar mass
 (ii) van't Hoff factor (*i*)

Delhi 2017

4. Define the following terms:
 (i) Abnormal molar mass
 (ii) van't Hoff factor

Delhi 2017

5. pH value of buffer solutions is ____.

Chhattisgarh Board-2023

6. What is molar volume? How much volume would be occupied by 16.5 mo of an ideal gas at standard temperature and pressure (STP, 273 K, 1 bar)?

NIOS Board-2015

7. Name the adsorbent used to removal of colouring matter from solution.

Karnataka Board-2017

8. Define molar volume of a gas. What is the molar volume of an ideal gas at STP (273 K, 1 bar)?

NIOS Board-2014

9. A solution, prepared by dissolving 10 g of a non-volatile solute in 200 g of water, has a vapour pressure of 31.84 mm of Hg at 308 K. The vapour pressure of pure water at 308 K is 32 mm of Hg. Calculate the molar mass of the solute.

Goa Board-2019

10. What will be the value of Van't Hoff factor for ethanoic acid in benzene?

Rajasthan Board-2016

11. What are lyophilic and lyophobic sols? Explain with examples.

Jharkhand Board-2023

12. The vapour pressure of pure benzene at a certain temperature is 0.850 bar. A non-volatile, solid weighing 0.5 g is added to 39.0 g of benzene (molar mass 78 g mol⁻¹). The vapour pressure of the solution obtained is 0.845 bar. What is the molar mass of the solid substance?

Jharkhand Board-2023

Section-C : Short Answer

1. The boiling point elevation of 0.30 g acetic acid in 100 g benzene is 0.0633 K. Calculate the molar mass of acetic acid from this data. What conclusion can you draw in the solution? (Given, K_b for benzene = 2.53 K kg mol⁻¹).

HOTS; All India 2008C

2. Calculate the temperature at which a solution containing 54 g of glucose ($C_6H_{12}O_6$) in 250 g of water will freeze. (K_f for water = 1.86 K kg mol⁻¹ and molar mass of glucose = 180 g mol⁻¹).

Delhi 2008; all India 2008; foreign 2008

3. A solution containing 8 g of a substance in 100 g of diethyl ether boils at 36.86°C, whereas pure ether boils at 35.60°C. Determine the molecular mass of the solute (for ether, K_b = 2.02 K kg mol⁻¹).

All India 2008; foreign 2008

4. 100 mg of a protein is dissolved in just enough water to make 10.0 mL of solution. If this solution has an osmotic pressure of 13.3 mm Hg at 25°C, what is the molar mass of the protein?
 $(R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$ and 760 mm Hg = 1 atm).

Delhi 2009; All India 2009

5. A solution prepared by dissolving 1.25 g of oil of wintergreen (methyl salicylate) in 99.0 g of benzene has a boiling point of 80.31°C. Determine the molar mass of this compound. (Boiling point of pure benzene = 80.10°C and K_b for benzene = 2.53°C kg mol⁻¹).

Delhi 2010; Foreign 2010

6. 15.0 g of unknown molecular material is dissolved in 450 g of water. The resulting solution freezes at -0.34°C. What is the molar mass of the material?
 $(K_f$ for water = 1.86 K kg mol⁻¹).

All India, 2010

7. A solution of glycerol ($C_3H_8O_3$) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42°C, what mass of glycerol was dissolved to make this solution?
 $(K_b$ for water = 0.512 K kg mol⁻¹).

All India 2012; Delhi 2012, 2010

8. 1.00 g of a non-electrolyte solute when dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K. Find the molar mass of the solute. (K_f for benzene = 5.12 K kg mol⁻¹)

All India 2013

9. **200 cm³ of an aqueous solution of a protein contains 1.26 gm of the Protein. The osmotic pressure of such a solution at 300K is found to be 2.57×10^{-3} atm. Calculate the molar mass of the protein.** [1]

Uttarakhand Board-2019

10. **Define the following terms:**

- (i) Van't Hoff factor
- (ii) Molarity

Haryana Board-2018

11. **How many gram of NaCl is required to make 200mL aqueous solution of 5% (w/v)NaCl.**

Rajasthan Board-2018

12. **Can we separate the compounds of azeotropic mixture by fractional distillation? Explain.**

Rajasthan Board-2014

13. **Theoretical molar mass and observed molar mass of ionic compound AB are 58.2 and 30 respectively. Calculate its van't Hoff factor and degree of dissociation.**

Rajasthan Board-2010

Section-E : Long Answer

1. **The freezing point depression constant for water is $1.86^\circ\text{C m}^{-1}$. If 5.0 g of Na_2SO_4 is dissolved in 45g of water, then freezing point is changed by 3.80°C . Calculate the Van't Hoff factor for Na_2SO_4 .**

Assam Board-2022

2. **A solution, prepared by dissolving 10 g of a non-volatile solute in 200 g of water, has a vapour pressure of 31.84 mm of Hg at 308 K. The vapour pressure of pure water at 308 K is 32 mm of Hg. Calculate the molar mass of the solute.**

Goa Board-2023

3. a) **The vapour pressure of pure benzene at certain temperature is 0.850 bars. A non volatile, non-electrolyte solid weighing 0.5 grams when added to 39 grams of benzene (molar mass 78g), vapour pressure of the solution, then is 0.845 bars. What is the molar mass of the solid substance?**
 b) **What happens to the solubility of a gas in a liquid with increase in temperature? Give reason.**

Karnataka Board-2014

4. a) **Vapour pressure of benzene is 200 mm of Hg. When 2 gram of a non-volatile solute dissolved in 78 gram benzene, benzene has vapour pressure of 195 mm of Hg. Calculate the molar mass of the solute, [molar mass of benzene is 78 gram mol⁻¹].**

- b) **What are azeotropes? Give an example for binary solutions showing minimum boiling azeotrope.**

Karnataka Board-2020

- a) **The boiling point of benzene is 353.23K when 1.80 g of a non-volatile, non-ionizing solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute.**

[Given K_b for benzene = 2.53K kg mol^{-1}]

- b) **Write two differences between ideal and non-ideal solutions.** (3 + 2)

Karnataka Board-2015

- a) **The vapour pressure of pure benzene at certain temperature is 0.850 bars. A non volatile, non-electrolyte solid weighing 0.5 grams when added to 39 grams of benzene (molar mass 78 grams), vapour pressure of the solution, then is 0.845 bars. What is the molar mass of the solid substance?**

Karnataka Board-2017

- a) **5.8 g of a non-volatile, non-electrolyte solute was dissolved in 100 g of carbon disulphide (CS_2). The vapour pressure of the solution was found to be 190 mm of Hg. Calculate molar mass of the solute.**

Given vapour pressure of pure CS_2 is 195 mm of Hg and Molar mass CS_2 is 76 g/mol.

3

- b) **Mention any two difference between ideal and non-ideal solution.** 2

Karnataka Board-2018

- 1.0 g of a nonelectrolyte solute dissolved in 50g of benzene lowered the freezing point of benzene by 0.40 K. The freezing point depression constant of benzene is $5.12\text{ K kg mol}^{-1}$. Find the molar mass of the solute.

Assam Board-2019

- (a) **Why limiting molar conductivity of CH_3COOH cannot be determined experimentally?**

- (b) **How many coulombs of charge are required to produce 20.0 g of calcium from calcium chloride?**

- (c) **What is a salt bridge? Give two functions of salt bridge.**

Meghalaya Board-2018

14. In an electrochemical cell

- (a) Chemical energy changes into electrical energy
- (b) Kinetic energy changes into electrical energy
- (c) Potential energy changes into kinetic energy
- (d) Kinetic energy changes into chemical energy

NIOS Board-2016

Ans. (a)

15. One Faraday contains the charge

- (a) 95000 C
- (b) 96500 C
- (c) 94500 C
- (d) 95600 C

Punjab Board-2021

Ans. (b)

16. Which of the following statements is true for an electrochemical cell formed by the combination of hydrogen electrode and copper electrode?

- (a) H₂ is anode and Cu is cathode
- (b) H₂ is cathode and Cu is anode
- (c) Reduction occurs at H₂ electrode
- (d) Oxidation occurs at Cu electrode

NIOS Board-2023

Ans. (a)

17. The electrode potential of standard hydrogen electrode is

- (a) 0
- (b) +1
- (c) -1
- (d) 0.75

Rajasthan Board-2011

Ans. (a)

18. For a reaction E_a=0, K=4.2×10⁵ sec⁻¹ at 300 K, the value of K at 310 K will be:

- (a) 4.2×10⁵ sec⁻¹
- (b) 8.4×10⁵ sec⁻¹
- (c) 8.4×10⁻⁵ sec⁻¹
- (d) 4.2×10⁻⁵ sec⁻¹

Tamilnadu Board, March-2016

Ans. (a)

19. Which of the following gives Cl₂ gas at anode and H₂ gas at cathode on electrolysis?

- (a) concentrated solution of NaCl
- (b) molten NaCl
- (c) dilute solution of NaCl
- (d) solid NaCl

Gujarat Board-2017

Ans. (a)

20. The unit of cell constant is

- (a) ohm⁻¹ cm⁻¹
- (b) cm
- (c) ohm⁻¹ cm
- (d) cm⁻¹

Jharkhand Board-2023

Ans. (d)

21. The primary cells are

- (a) rechargeable
- (b) non-rechargeable
- (c) everlasting
- (d) short lasting

Nagaland Board-2017

Ans. (b)

Section-B : Very Short Answer

1. How much charge in terms of Faraday is required to reduce one mol of MnO₄⁻ to Mn²⁺?

CBSE-2020

two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) true, but Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false

(d) Assertion (A) is false, but Reason (R) is true.

2. Assertion (A) : E^o_{Cu²⁺/Cu} is positive (+0.34V)

Reason (R): Copper has high Δ_aH° and low Δ_{hyd}H

Gujarat Board 2023 (July)

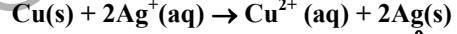
3. What is electrochemical series ? Give its applications.

Haryana Board 2023

4. Give an example for inert electrode.

Karnataka board 2023

5. Calculate the equilibrium constant of the following reaction-



$$E_{(\text{cell})}^{\theta} = 0.46\text{V}$$

Uttarakhand Board 2022

How many coulombs are required for the oxidation of 1 mol of H₂O to O₂ ?

CBSE-2020

7. Calculate the emf of the following cell :



Given, E_{cell}^o = 1.56 V,

$$[\log 2 = 0.3010, \log 4 = 0.6021, \log 10 = 1]$$

CBSE-2022

8. Define electrochemical cell. What happens if external potential applied becomes greater than E_{cell}^o ?

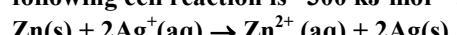
CBSE-2022

9. (i) Why on dilution the ^m of CH₃COOH increases very fast, while that of CH₃COONa increases gradually ?

(ii) What happens if external potential applied becomes greater than E_{cell}^o of electrochemical cell ?

CBSE-2022

10. (a) The standard Gibbs energy (ΔrG°) for the following cell reaction is -300 kJ mol⁻¹ :



Calculate E_{cell}^o for the reaction. (Given: 1F = 96500 mol⁻¹)

- (b) Calculate λ_m^o for $MgCl_2$ if λ^o values for Mg^{2+} ion and Cl^- ion are $106 \text{ S cm}^2 \text{ mol}^{-1}$ and $76.3 \text{ S cm}^2 \text{ mol}^{-1}$ respectively.
- CBSE-2022
11. Define electrochemical cell. What happens when applied external potential becomes greater than E_{cell}^o of electrochemical cell ?
- CBSE-2019
12. An electrochemical cell converts.....energy toenergy.
- ISC Board-2014
13. What happens when a nickel rod is dipped into a copper sulphate solution ? Justify your answer.
- $(E_{Ni^{2+}/Ni}^o = -0.25 \text{ V} \text{ and } E_{Cu^{2+}/Cu}^o = 0 + .34 \text{ V})$
- ISC Board-2014
14. According to Faraday's law, one gram equivalent of ion is liberated by
- ISC Board-2002
15. (i) State Faraday's first law of electrolysis.
(ii) How many electrons will flow when a current of 5 A is passed through a solution for 200 s ?
- ISC Board-2011
16. Name the law or principle confirmed by the following observation.
When 96500 C of electricity is passed through acidulated water, 5.6 L of oxygen at STP is liberated at the anode.
- ISC Board-2013
17. How many hours does it take to reduce 3 moles of Fe^{3+} to Fe^{2+} with 2.0 A current intensity?
- ISC Board-2016
18. Calculate the number of coulombs required to deposit 5.4 g of Al, when the electrode reaction is
- $$Al^{3+} + 3e^- \rightarrow Al$$
- [Atomic weight of AL = 27 g/mol]
- ISC Board-2016
19. Define electrochemical cell. What happens if external potential applied becomes greater than E_{cell}^o of electrochemical cell ?
- All India 2016
20. The standard electrode potential (E^o) for Daniell cell is $+1.1 \text{ V}$. Calculate the ΔG^o for the reaction
 $Zn(s) + Cu^{2+}(\text{aq}) \rightarrow Zn^{2+}(\text{aq}) + Cu(s)$
 $(1F = 96500 \text{ C mol}^{-1})$.
- All India 2013
21. The standard electrode potential for Daniell cell is 1.1 V . Calculate the standard Gibbs energy for the cell reaction. ($F = 96500 \text{ C mol}^{-1}$)
- Delhi 2013C
22. Write the unit of cell constant.
- Odisha Board-2017
23. If at 25°C , the standard emf of the cell $|Zn(s)|Zn^{2+}(1\text{M})||Cu^{2+}(0.1\text{M})|Cu(s)$ is 1.3 volt, calculate the emf of the cell.
- Odisha Board-2020
24. What is the relation between standard Gibbs free energy and standard emf of the cell?
- Odisha Board-2020
25. What are primary cells and secondary cells?
- Manipur Board-2017
26. What is meant by Faraday constant? How much charge is required for reduction of 1 mole of Al^{3+} ion to Al?
- Manipur Board-2017
27. What is a secondary cell?
- Karnataka Board-2020
28. State Faraday's Second law of electrolysis.
- Karnataka Board-2019
29. How many Faraday of electricity is required to reduce 1 mole of MnO_4^- ions to Mn^{2+} ions?
- Karnataka Board-2018
30. Which gas is evolved at cathode during the electrolysis of an aqueous solution of $NaCl$?
- Karnataka Board-2016
31. State Faraday's first law of electrolysis. For the electrode reaction,
 $Zn^{+2} + 2e^- \rightarrow Zn_{(s)}$ what quantity of electricity in coulombs is required to deposit one mole of zinc.
- Karnataka Board-2015
32. Calculate the e.m.f at 25°C of an electrochemical cell in which the following reaction occurs:
 $Mg(s) + Cu^{2+}(\text{aq}) \rightarrow Mg^{2+}(\text{aq}) + Cu(s)$ and the concentration of Mg^{2+} ions is 100 times more than Cu^{2+} ions.
- Given $E_{Cu^{2+}/Cu}^o = 0.34 \text{ V}$, $E_{Mg^{2+}/Mg}^o = -2.37 \text{ V}$
- Goa Board-2018
33. How many Faraday of electricity is required to reduce 1 mole of $Cr_2O_7^{2-}$ ions into Cr^{3+} ions?
- Karnataka Board-2020
34. How many Coulombs of electricity required to oxidise one mole of Al to Al^{3+} ?
- Karnataka Board-2015
35. State Faraday's first law of electrolysis.
- Karnataka Board-2019
36. Define :
(a) Semipermeable membrane
(b) Reference electrode
- Maharashtra board-2018
37. Calculate standard Gibbs energy change at 25°C for the cell reaction
 $Cd(s) + Sn^{2+}(\text{aq}) \rightarrow Cd^{2+}(\text{aq}) + Sn(s)$
- $E_{Cd}^o = -0.403 \text{ V}$, $E_{Sn}^o = -0.136 \text{ V}$
- Maharashtra board-2023
38. In the electrode of first kind Cl_2/Cl^- , the electrode material Cl_2 is a nonconductor. How can the electron transfer be carried out with the ion (Cl^-) ?
- Manipur Board-2019
39. State Faraday's first law of electrolysis.
- Andhra Pradesh Board-2018, 2016

40. Write the chemical equation of reaction taking place on the anode in cadmium-nickel storage cell.
Rajasthan Board-2020
41. Define standard electrode potential.
Assam Board-2018
42. Fill in the blanks:
(c) The Potential value of standard hydrogen electrode is
MP Board-2016
43. Match the pairs correctly (choose the correct answer from Section 'B' for Section 'A'):
 Section 'A' Section 'B'
 (a) One Faraday (i) H_2SO_4
 (b) Arrhenius equation (ii) HF
 (c) Haematite (iii) 96500 coulombs
 (d) Contact process (iv) $K = Ae^{-E_a/RT}$
 (v) Iron
 (vi) $H_2S_2O_8$
 (vii) Group 18
MP Board-2013
44. Correct formula of calomel is
MP Board-2012
45. Define standard electrode potential.
Nagaland Board-2020
46. What is salt bridge ?
Nagaland Board-2018

Section-C : Short Answer

1. Calculate the e.m.f of the cell.
 $Mg(s)|Mg^{2+}(0.1\text{ M})||Cu^{2+}(1 \times 10^{-1}\text{ M})|Cu(s)$
 Given $E_{Cu^{2+}/Cu}^{\circ} = 0.34\text{ V}$
 $E_{Mg^{2+}/Mg}^{\circ} = -2.37\text{ V}$
UP Board 2019
2. Calculate the half-cell potential at 298 K for the reaction
 $Zn^{2+} + 2e^- \rightarrow Zn$
 if $[Zn^{2+}] = 0.1\text{ M}$ and $E_{Zn^{2+}/Zn}^{\circ} = -0.76\text{ V}$
Gujarat Board 2023 (July)
3. At 298 K write Nernst equation for the following cell –
 $Ni|Ni^{2+}(0.01)||Cu^{2+}(0.1\text{ M})|Cu$
 If the emf of the above cell (E_{cell}) is 0.59 V then calculate the standard emf of the cell (E_{cell}°).
UP Board 2023
4. When a steady current of 2A was passed through two electrolytic cells A and B containing electrolytes $ZnSO_4$ and $CuSO_4$ connected in series, 2 g of Cu were deposited at the cathode of cell B. How long did the current flow ?
 What mass of Zn was deposited at cathode of cell A ?
 [Atomic mass : Cu = 63.5 g mol^{-1} , Zn = 65 g mol^{-1} , 1F = 96500 C mol^{-1}]
CBSE-2020
5. (a) Calculate e.m.f. of the following cell :
 $Zn(s)/Zn^{2+}(0.1\text{ M}) || (0.01\text{ M}) Ag^+/Ag(s)$
 Given : $E_{Zn^{2+}/Zn}^{\circ} = -0.76\text{ V}$, $E_{Ag^+/Ag}^{\circ} = +0.80\text{ V}$
 [Given : $\log 10 = 1$]
 (b) X and Y are two electrolytes. On dilution molar conductivity of 'X' increases 2.5 times while that Y increases 25 times. Which of the two is a weak electrolyte and why ?
CBSE-2020
6. (a) Calculate ΔG° for the reaction
 $Zn(s) + Cu^{2+}(\text{aq}) \rightarrow Zn^{2+}(\text{aq}) + Cu(s)$.
 Given: E° for $Zn^{2+}/Zn = -0.76\text{ V}$ and
 E° for $Cu^{2+}/Cu = +0.34\text{ V}$
 $R = 8.314\text{ J K}^{-1}\text{ mol}^{-1}$
 $F = 96500\text{ C mol}^{-1}$
 (b) Give two advantages of fuel cells.
CBSE-2020
7. Calculate E_{cell}° and $\Delta_r G^{\circ}$ for the following reaction at 298 K:
 $A + B^{2+}(0.001\text{ M}) \rightarrow A^{2+}(0.0001\text{ M}) + B$
 [Given : $E_{cell}^{\circ} = 2.6805\text{ V}$, 1 F = 96,500 C mol^{-1} ,
 $\log 10 = 1$]
CBSE-2020
8. For the cell, $Cu|Cu^{2+}(0.13\text{ M}) || Ag^+(0.01\text{ M})|Ag$
 (i) Calculate the reduction potential of each electrode if the standard reduction potential for copper and silver electrodes are 0.34 V and 0.80 V respectively.
 (ii) Calculate the emf of the cell
 (iii) Write the cell reaction.
 (iv) Is this cell reaction spontaneous ? Why ?
ISC Board-2001
9. For the following cell, calculate the emf.
 $Al|Al^{3+}(0.01\text{ M}) || Fe^{2+}(0.02\text{ M})|Fe$
 Given, $E_{Al^{3+}/Al}^{\circ} = -1.66\text{ V}$,
 $E_{Fe^{2+}/Fe}^{\circ} = -0.44\text{ V}$
ISC Board-2009
10. Calculate the maximum work that can be obtained from the given electrochemical cell constructed with two metals M and N.
 $(E_{M^{2+}/M}^{\circ} = -0.76\text{ V}, E_{N^{2+}/N}^{\circ} = +0.34\text{ V})$
 The cell reaction is
 $M + N^{2+} \rightarrow M^{2+} + N$
ISC Board-2012
11. Name the law of principle to which the following observations confirm:
 When 9650 coulombs of electricity is passed through a solution of copper sulphate, 3.175 g of copper is deposited on the cathode (At wt. of Cu = 63.5)
ISC Board-2017
12. Calculate the e.m.f. of the following cell at 298 K – $Zn|Zn^{2+}(0.01\text{ M}) || Ag^+(1.0\text{ M})|Ag$
 $E_{(Cell)}^{\circ} = 1.56\text{ V}$ at 298 K
Uttarakhand Board-2020

13. Derive the Nernst equation of electrode potential at 25°C for the electrode reaction



Odisha Board-2017

14. (b) Describe the construction and function of standard Hydrogen Electrode.

Tamil Nadu Board-2015

15. Calculate the e.m.f. of the cell:



$$E_{Ag}^{\circ} | Ag^+ = +0.80V, E_{Zn}^{\circ} | Zn^{2+} = -0.76V.$$

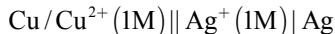
Tamil Nadu Board-2011

16. A solution of CuSO₄ is electrolysed for 10 minutes with a current of 1.5 amperes. What is mass of copper deposited at Cathode ? (Cu^{63.5})

Haryana Board-2021

17. a) Find the value of ΔG° at 25° C for the following electrochemical cell. (3 + 2)

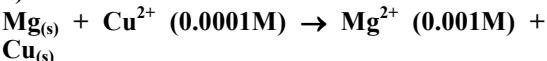
- b) Write the equations of anodic and cathodic reactions occur during rusting of iron.



$$[E_{cell}^{\circ} = 0.34V, E_{Ag}^{\circ} = 0.8V] F = 96487C$$

Karnataka Board-2016

18. a) Calculate e.m.f. of the cell for the reaction:



- b) Write the overall cell reaction in mercury cell.

Karnataka Board-2019

19. Define electrochemical series. Write its applications.

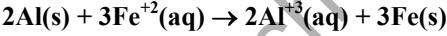
Maharashtra board-2019

20. Discuss standard hydrogen electrode.

Jharkhand Board-2020

21. State Faraday's First Law of Electrolysis.

Calculate the standard Gibb's free energy of an electrochemical cell in which the following reaction occurs at 25°C:



Given:

$$E_{Al^{+3}/Al}^{\circ} = -1.66V$$

$$E_{Fe^{+2}/Fe}^{\circ} = -0.44V$$

$$F = 96500 C$$

Goa Board-2019

22. Draw a labelled diagram of 'Standard Hydrogen Electrode'.

Rajasthan Board-2018, 2015

23. Write the half-reactions of oxidation and reduction taking place on electrodes.

Rajasthan Board-2013

24. What is the difference between electrochemical equivalent and chemical equivalent? How are both related to each other?

Rajasthan Board-2010

25. Write the equations for the reactions taking place at anode and cathode in lead storage cell.

Gujarat Board-2017

26. The cell potential for the following cell is 0.576 V at 298K. Calculate the pH of the solution :



$$\text{Given } E_{(Cu^{2+}/Cu)}^{\circ} = 0.34V$$

Assam Board-2023

Section-D : Case Based Study

1. Calculate the emf of the following cell at 298 K: Al (s) | Al³⁺ (0.001M) || Ni²⁺ (0.1 N) Ni (s)
[Given : E_{Al³⁺/Al}⁰ = -1.66V, E_{Ni²⁺/Ni}⁰ = -0.25V, log 10 = 1]

Gujarat Board 2023 (July)

Read the passage given below and answer the questions that follow:

An electrochemical cell consists of two metallic electrodes dipping in electrolytic solutions. Electrochemical cell are of two types. In galvanic cell, the chemical energy of spontaneous redox reaction is converted into electrical work, whereas in an electrolytic cell, electrical energy is used to carry out a non-spontaneous redox reaction. The standard electrode potential for any electrode dipping in an appropriate solution is defined with respect to standard electrode potential of hydrogen electrode taken as zero.

The conductivity (k) of an electrolytic solution depends on the concentration of the electrolyte, nature of solvent and temperature. Both conductivity and molar conductivity (Λ_m) very with concentration of solution.

- (i) Depict the galvanic cell in which the following reaction takes place:



- (ii) What happens when external potential applied is greater than E_{cell}⁰ of electrochemical cell ?

- (iii) How do conductivity and molar conductivity vary with concentration?

- (iv) (a) Calculate Δ_rG⁰ of the following reaction :



$$\text{Given: } E_{cell}^{\circ} = 1.56 V, 1F = 96500 C mol^{-1}$$

CBSE-2022

Section-E : Long Answer

1. (a) Calculate the emf and ΔG of the following cell at 298 K:
Mg(s) | Mg²⁺ (10⁻³M) || Cu²⁺ (10⁻⁴M) | Cu (s)
Given : E_{cell}⁰ = +2.70V, 1F = 96500 C mol⁻¹, log 10 = 1

CBSE-2021

2. (i) Calculate the $\Delta_r G^\circ$ and $\log K_c$ for the following reaction :
- $$\text{Fe}^{2+}(\text{aq}) + \text{Ag}^+(\text{aq}) \longrightarrow \text{Fe}^{3+}(\text{aq}) + \text{Ag}(\text{s})$$
- $$E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = +0.77 \text{ V}, E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$$
- (ii) State Kohlrausch's law of independent migration of ions. Write its one application.
- CBSE-2021
3. What is free energy ? Derive Gibbs-Helmholtz equation.
- Chhattisgarh Board-2023
4. What is entropy ? Calculate standard entropy change at 298 K for the following reaction :
- $$\text{P}_4 + \text{SO}_2 \rightarrow \text{P}_4\text{O}_{10}$$
- Given at 298 K
- S° for $\text{P}_4 = 41.1 \text{ JK}^{-1} \text{ mol}^{-1}$
- S° for $\text{O}_2 = 205 \text{ JK}^{-1} \text{ mol}^{-1}$
- S° for $\text{P}_4\text{O}_{10} = 231.0 \text{ JK}^{-1} \text{ mol}^{-1}$
- Chhattisgarh Board-2023
5. (a) Derive Henderson equation.
 (b) Write IUPAC representation of a cell.
- Tamil Nadu Board-2011
6. Calculate the standard emf and standard free energy change of the following cell:
- $$\text{Zn} | \text{Zn}^{2+} \parallel \text{Cu}^{2+} | \text{Cu}$$
- $$E^\circ_{\text{zn}^{2+}/\text{zn}} = -0.762 \text{ V}, \text{ and } E^\circ_{\text{cu}^{2+}/\text{cu}} = +0.337 \text{ V}$$
- Tamil Nadu Board-2011
7. (a) What is a salt-bridge ? What would happen if salt bridge is not used in an electrochemical cell?
 (b) In the cell $\text{Ni}_{(s)}|\text{Ni}^{2+}(0.001 \text{ M}) \parallel \text{Ag}^+(0.1 \text{ M})\text{Ag}_{(s)}$
- NIOS Board-2018
8. a) State Faraday's First law of electrolysis. Writes its mathematical form using usual notations.
 b) State Kohlrausch law.
- Karnataka Board-2016
- (b). Derive the relationship between EMF and free energy.
- Tamil Nadu Board-2016
9. (a) What is electrochemical series? Certain metals A, B, C, D, E, F and hydrogen have been arranged according to their standard electrode potentials as given below :
 $A < B < C < H_2 < D < E < F$
 All these metals form dipositive ions such as A^{2+} , B^{2+} , etc.
 (i) Identify the metals having the maximum and minimum reducing powers.
 (ii) Identify any two metals which can liberate hydrogen from acids.
 (iii) Can A reduce the cation of C? Explain.
 (b) Give reasons for the following :
 (i) Activated charcoal is used in gas masks.
 (ii) Silica gel packed in small cloth bags is kept in the bottles of medicines.
- NIOS Board-2014
10. (a) Complete the following equation by ion electron half-reaction method:
 $\text{MnO}_4^- + \text{Fe}^{2+} \rightarrow \text{Mn}^{2+} + \text{Fe}^{3+}$ (acidic medium)
 (b) Calculate the e.m.f. of the following cell at 25 °C:
 $\text{Mg}(\text{s}) | \text{Mg}^{2+}(0.001 \text{ M}) \parallel \text{Cu}^{2+}(0.0001 \text{ M}) | \text{Cu}(\text{s})$
 [Given : $E^\circ_{\text{Mg}^{2+}/\text{Mg}} = -2.37 \text{ V}$, $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$]
- NIOS Board-2011
11. (i) State Faraday's first and second law's of electrolysis. A solution of CuSO_4 is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode?
 (ii) What is molecularity of a reaction. How is it different from the order of a reaction? Name one bimolecular and one trimolecular gaseous reactions.
- Andhra Pradesh Board-2020
12. Define enthalpy of formation from the data given below, calculate the standard enthalpy for the reaction.
 $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$
 Is it an exothermic or an endothermic reaction ?
 Given : $\Delta H_f^\circ(\text{H}_2\text{O(l)}) = -188 \text{ kJ mol}^{-1}$;
 $\Delta H_f^\circ(\text{H}_2\text{O(l)}) = -286 \text{ kJ mol}^{-1}$,
 $\Delta H_f^\circ(\text{O}_2(\text{g})) = 0 \text{ kJ mol}^{-1}$.
- NIOS Board-2022
13. (i) What is meant by polyprotic acid? Give two examples of polyprotic acid.
 (ii) Standard electrode potential of metals A, B, C, D and E are given below:
 $\text{A}^+/A = -2.93 \text{ V}, \text{B}^+/B = +0.80, \text{C}^{2+}/\text{C} = +0.79 \text{ V}, \text{D}^{2+}/\text{D} = -2.37 \text{ V}$ and $\text{E}^{3+}/\text{E} = -0.74 \text{ V}$.
 Arrange them in increasing order of their reducing power. Give reason.
- NIOS Board-2023
14. a) The cell in which the following reaction occurs $2\text{Fe}^{3+}(\text{aq}) + 3\text{I}^-(\text{aq}) \rightarrow 2\text{Fe}^{3+}(\text{aq}) + \text{I}_{2(\text{s})}$
 has $E^\circ_{\text{cell}} = 0.236 \text{ V}$ at 298 K. Calculate the Standard Gibb's energy ($F = 96487 \text{ C mol}^{-1}$)
 b) What are secondary cells (batteries)? Give one example.
- Karnataka Board-2020
15. a) Calculate the equilibrium constant for the reaction.
 $\text{Cu}(\text{s}) + 2\text{Ag}^+(\text{aq}) + 2\text{Ag}(\text{s}); E^\circ_{\text{cell}} = 0.46 \text{ V}$
 b) Write half cell reaction and E° value of (SHE) standard hydrogen electrode.
- Karnataka Board-2017

16. a) Calculate e.m.f. of the cell in which the reaction takes place:
- $$\text{Ni}_{(s)} + 2\text{Ag}^{2+}_{(aq)} (0.002\text{M}) \rightarrow \text{Mg}^{2+}_{(q)} (0.160\text{M}) + \text{Cu}_{(s)}$$
- Given: $E_{cell}^{\circ} = 1.05\text{V}$
- b) State Faraday's electricity is required for the reduction of 1 mole of Mg^{2+} ions.
- Given : Given: $E_{cell}^{\circ} = 1.05\text{V}$, $\text{Ni}^{2+} = 0.160\text{ M}$, $[\text{Ag}^{+}]_2 = 0.002\text{ M}$, $n = 2$.
- Karnataka Board-2018
17. Define reference electrode. Write function of salt bridge. Draw neat, labelled diagram of standard hydrogen electrode (SHE).
- Maharashtra board-2022
18. The following electrochemical cell is set up at 298 K:
 $\text{Zn}/\text{Zn}^{2+}(\text{aq})(1\text{M})/\text//\text{Cu}^{2+}(\text{aq})(1\text{M})/\text{Cu}$
 Given $\rightarrow E^{\circ}\text{Zn}^{2+}/\text{Zn} = -0.761\text{V}$, $E^{\circ}\text{Cu}^{2+}/\text{Cu} = +0.339\text{V}$
- (1) Write the cell reaction,
 (2) Calculate the emf and free energy change at 298 K.
- ISC Board-2017
19. Daniell cell converts the chemical energy liberated during the redox reaction to electrical energy.
- $$\text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Zn}^{2+}_{(aq)} + \text{Cu}_{(s)}; E_{cell}^{\circ} = 1.1\text{V}$$
- (a) Identify the anode and cathode in Daniell cell.
 (b) Calculate the standard Gibbs energy ($\Delta_r G^{\circ}$) for the reaction.
 (c) Give the Nernst equation of above cell reaction.
- Kerala Board-2020
20. What is standard hydrogen electrode? Explain with diagram.
- Chhattisgarh Board-2020
21. What is electrochemical cell? Explain its working with the help of diagram.
- Chhattisgarh Board-2020
22. Describe the construction and working of Normal Hydrogen Electrode.
- Haryana Board-2017
23. (b) Write any five common terms in Cell Terminology.
- Tamilnadu Board, March-2016
24. Define an electrochemical cell. What is salt bridge and give its function?
- Haryana Board-2016
25. What is standard hydrogen electrode? How is it prepared? Explain with labelled diagram.
- MP Board-2014
26. (a) Represent the cell in which the following reaction takes place:
 $\text{Mg(s)} + 2\text{Ag}^{+} (0.0001\text{M}) \rightarrow \text{Mg}^{2+} (0.130\text{M}) + 2\text{Ag(s)}$
 Calculate its E_{cell} if
 $E_{\text{Mg/Mg}^{2+}}^{\circ} = -2.37\text{ V}$ and $E_{\text{Ag}^{+}/\text{Ag}}^{\circ} = +0.80\text{ V}$
- Meghalaya Board-2021
27. The standard electrode potential, E_{cell}° for Daniell cell is 1.1 V. Calculate ΔG° for the reaction $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu(s)}$
- Δ_m° for NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 $\text{S cm}^2 \text{ mol}^{-1}$ respectively. Calculate the Δ_m° for CH_3COOH .
28. Write the Nernst equation for the reaction $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Cu(s)}$
- Meghalaya Board-2021

B. Galvanic Cells

Section-A : Multiple Choice Questions

1. In which of the following condition reduction potential of hydrogen half cell will be negative?
 (a) $\text{PH}_2 = 1\text{ atm}$ and $[\text{H}^{+}] = 2\text{M}$
 (b) $\text{PH}_2 = 2\text{ atm}$ and $[\text{H}^{+}] = 1\text{M}$
 (c) $\text{PH}_2 = 1\text{ atm}$ and $[\text{H}^{+}] = 1\text{ M}$
 (d) $\text{PH}_2 = 2\text{ atm}$ and $[\text{H}^{+}] = 2\text{M}$

Gujarat Board 2023 (March)

Ans. (b)

2. Which substance is used as cathode in mercury cell?
 (a) $\text{ZnO} + \text{NaOH}$ (b) $\text{ZnO} + \text{Pt}$
 (c) $\text{HgO} + \text{KOH}$ (d) $\text{HgO} + \text{C}$

Gujarat Board 2023 (March)

Ans. (d)

3. In the following reaction, what is the value of equilibrium constant?
 $\text{Cu}_{(s)} + 2\text{Ag}^{+}_{(aq)} \rightarrow \text{Cu}^{2+}_{(aq)} + 2\text{Ag}_{(s)}$ $E_{cell}^{\circ} = 0.46\text{V}$

- (a) 3.92×10^0 (b) 3.92×10^{15}
 (c) 39.2×10^{15} (d) 3.92×10^{14}

Gujarat Board-2021

Ans. (b)

4. Standard free energies of formation of elements are taken as:
 (a) High (b) Low
 (c) Zero (d) Very low

Tamil Nadu Board-2016

Ans. (c)

5. If ΔG for a reaction is negative, the change is:
 (a) Reversible
 (b) Spontaneous
 (c) Equilibrium
 (d) Non-spontaneous

Tamil Nadu Board-2018

Ans. (b)

6. Which device is used to measure exact value of cell-potential of an electrochemical cell?
 (a) Galvanometer (b) Ammeter
 (c) Potentiometer (d) Voltmeter

Gujarat Board-2017

Ans. (c)

7. Using the data given below. Find out the strongest reducing agent.

$$E_{\text{Mn}^{+4}/\text{Mn}^{+2}}^{\circ} = 1.23\text{V} \quad E_{\text{Co}^{+3}/\text{Co}^{+2}}^{\circ} = 1.81\text{V}$$

$$E_{\text{Fe}^{+2}/\text{Fe}}^{\circ} = -0.44\text{V} \quad E_{\text{Pb}^{+2}/\text{Pb}}^{\circ} = -0.13\text{V}$$

- (a) Mn^{+2} (b) Fe
 (c) Co^{+2} (d) Pb

Gujarat Board-2020

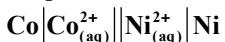
Ans. (b)

Section-B : Very Short Answer

1. Write anode and cathode reactions that occur in dry cell. How does a dry cell differ from a mercury cell ?

CBSE-2019

2. Calculate equilibrium constant for the reaction occurring in the following cell at 298 K temperature.



$$E^\ominus_{\text{Co}^{2+}/\text{Co}} = -0.28 \text{ V} \quad E^\ominus_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V}$$

Gujarat Board-2022 (July)

3. Calculate the E.M.F of the cell, $\text{Mg}(\text{s}) \parallel \text{Mg}^{2+}(0.1\text{M}) \parallel \text{Ag}^+(1 \times 10^{-3} \text{ M}) \mid \text{Ag}(\text{s})$

$$E^\ominus_{\text{Ag}^+/\text{Ag}} = +0.8 \text{ V}, E^\ominus_{\text{Mg}^{2+}/\text{Mg}} = -2.37 \text{ V}$$

What happens to the E.M.F if the concentration of Ag^+ is decreased to $1 \times 10^{-4} \text{ M}$? [given $\log 5 = 0.6990$]

Manipur Board 2020

4. Cryolite is used in the extraction of.....

ISC Board-2007,2008

5. In galvanic cell, electrons flow from.... to.....through the connecting wires.

ISC Board-2013

6. Write the overall reaction that occurs during use (discharging) of nickel-cadmium cell. Is it a primary or a secondary cell? Mention its one merit over the lead storage cell.

All India 2011C

7. Write the anode and cathode reactions occurring in a commonly used mercury cell. How is the overall reaction represented?

Foreign 2010

8. What is a nickel-cadmium cell? State its one merit and one demerit over lead storage cell. Write the overall reaction that occurs during discharging of this cell.

All India 2010C

9. What is primary cell? Give one example.

Delhi, Foreign 2008

10. Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell.

All India 2017

11. Write the name of the cell which is generally used in transistors. Write the reactions taking place at the anode and the cathode of this cell.

All India 2017

12. A zinc rod is dipped in 0.1 M solution of ZnSO_4 . The salt is 95% dissociated at this dilution at 298 K. Calculate the electrode potential.

Delhi 2012C

13. Represent the galvanic cell in which the reaction, $\text{Zn}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu}(\text{s})$ takes place.

Delhi 2013C

14. What is the necessity to use a salt bridge in a Galvanic cell?

Delhi 2011C

15. Calculate the potential of hydrogen electrode in contact with a solution whose

Punjab Board-2021

16. $\Delta G < 0$ for adsorption before attaining equilibrium. Give reason.

Karnataka Board-2020

17. More _____ is the standard reduction potential of a substance, the _____ is its ability to displace hydrogen from acids.

ISC Board-2017

18. The galvanic cells which are used to convert the energy of combustion of fuels like hydrogen, methane etc into electrical energy are generally called as _____

Kerala Board-2022

Section-C : Short Answer

1. Zinc metal and chlorine gas are utilized in a voltaic cell represented as

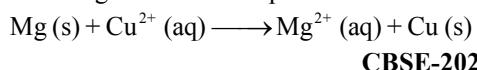


Write the half-cell reactions and calculate the standard potential of this cell at 25°C (given that $\Delta^\ominus = -410 \text{ kJ}$)

Manipur Board 2023

2. Answer the following questions (Any two) :

- (a) Why is alternating current used instead of direct current for measuring resistance of an electrolytic solution ?
 (b) State Kohlrausch's law of independent migration of ions.
 (c) Depict the Galvanic cell in which the following reaction takes place :



CBSE-2022

3. Consider the reaction $2\text{Ag}^+ + \text{Cd} \longrightarrow 2\text{Ag} + \text{Cd}^{2+}$. The standard reduction of Ag^+/Ag and Cd^{2+}/Cd are + 0.80 V and -0.40 V respectively.

- (i) Give the cell representation
 (ii) What is the standard cell emf, E^\ominus ?
 (iii) What will be the emf of the cell if concentration of Cd^{2+} is 0.1 M and Ag^+ is 0.2 M ?
 (iv) Will the cell work spontaneously for the condition shown in (iii) above ?

ISC Board-2016, 2011

4. Calculate the value of E_{cell} at 298 K for the following cell :

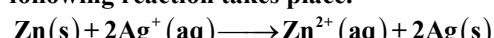


Given : $E^\ominus_{\text{Al}^{3+}/\text{Al}} = -1.66 \text{ V}$ and

$$E^\ominus_{\text{Sn}^{2+}/\text{Sn}} = -0.14 \text{ V}$$

ISC Board-2013

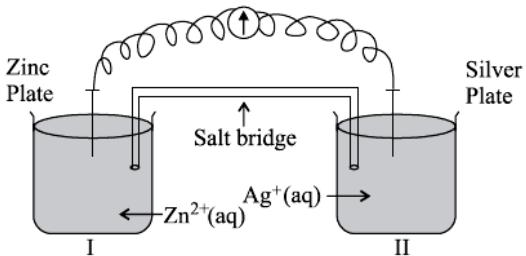
5. Formulate the galvanic cell in which the following reaction takes place.



- (i) Which one of its electrodes is negatively charged?
(ii) The reaction taking place at each of its electrode.
(iii) The carriers of current within this cell.
- Delhi 2008; All India 2008
6. Two half reactions of an electrochemical cell are given below:
 $MnO_4^- (aq) + 8H^+ (aq) + 5e^- \longrightarrow Mn^{2+} (aq) + 4H_2O (l)$; $E^\circ = +1.51\text{ V}$
 $Sn^{2+} (aq) \rightarrow Sn^{4+} (aq) + 2e^-$; $E^\circ = -0.15\text{ V}$
Construct the redox equation from the standard potential of the cell and predict, if the reaction is reactant favoured or product favoured.
- Delhi 2011; all India 2009
7. Calculate the equilibrium constant for the reaction between silver nitrate and metallic Zinc. $2Ag^+ + Zn^{2+} \rightleftharpoons +2Ag E_{cell}^\circ = 1.56\text{V}$.
- Tamil Nadu Board-2015
8. Calculate the potential of the following cell at 298 K
 $Zn/Zn^{2+}(a=0.1)/Cu^{2+}(a=0.01)/Cu$
- $E_{Zn^{2+}/Zn}^\circ = -0.762\text{ V}$
 $E_{Cu^{2+}/Cu}^\circ = +0.337\text{ V}$
- Tamil Nadu Board-2016
9. What is salt bridge? Mention its functions.
- Jharkhand Board-2020
10. Calculate the standard EMF of a cell involving cell reaction $Zn + 2Ag^+ \longrightarrow Zn^{2+} + 2Ag$ given:
 $E_{Zn/Zn^{2+}}^\circ = 0.76\text{ V}; E_{Ag/Ag^+}^\circ = -0.80\text{ V}$
- Haryana Board-2017
11. Calculate Standard Gibbs Free Energy for the given reaction: $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$. Given $E_{cell}^\circ = 1.10\text{V}$.
- Haryana Board -2016
12. (a) What are Galvanic cells ? Explain the working of Galvanic cells with one example.
(b) Write the differences between order and molecularity of a reaction.
- Andhra Pradesh Board-2018
13. (a) Explain the working of a galvanic cell with a neat sketch taking Daniell cell as example.
(b) State and explain Kohlrausch's Law of independent migration of ions.
- Andhra Pradesh Board-2021
14. Give overall reaction of Daniell cell and write mathematical expression of Nernst equation for it.
- Rajasthan Board-2014
15. The measured emf of the cell-
 $Pt(s)|H_2(g,1\text{bar})|H^+(aq,1\text{M})||Cu^{2+}(aq,\text{M})|Cu(s)$ is 0.34V .
- Assam Board-2018
16. Draw a labelled diagram of Galvanic cell and explain cell reaction.
- MP Board-2018
17. Draw a labelled diagram of Galvanic cell.
- J & K board-2023
18. (i) State Kohlrausch's law. Give its application.
(ii) Λ_m° for NaCl,HCl and CH₃COONa are 126.4, 425.9 and 91.0 S cm²mol⁻¹ respectively. Calculate Λ° for CH₃COOH.
- Nagaland Board-2020
19. What are primary cells? Calculate the equilibrium constant for the reaction at 298K.
 $Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$.
- $E_{Ag^+/Ag}^\circ = 0.80\text{V}$ and $E_{Cu^{2+}/Cu}^\circ = 0.34\text{V}$
- Nagaland Board-2020

Section-D : Case Based Study

1. Read the passage given below and answer the questions that follow :
- Oxidation-reduction reactions are commonly known as redox reactions. They involve transfer of electrons from one species to another. In a spontaneous reactions, energy is released which can be used to do useful work. The reaction is split into two half reactions. Two different containers are used and a wire is used to drive the electrons from one side to the other and a Voltaic/Galvanic cell is created. It is an electrochemical cell that uses spontaneous redox reaction to generate electricity. A salt bridge also connects to the half cells. The reading of the voltmeter gives the cell voltage or cell potential or electromotive force. If E_{cell}° is positive the reaction is spontaneous and if it is negative the reaction is non-spontaneous and is referred to as electrolytic cell. Electrolysis refers to the decomposition of a substance by an electric current. One mole of electric charge when passed through a cell will discharge half a mole of a divalent metal ion such as Cu²⁺. This was first formulated by Faraday in the form of laws of electrolysis.
- The conductance of material is the property of materials due to which a material allows the flow of ions through itself and thus conducts electricity. Conductivity is represented by k and it depends upon nature and concentration of electrolyte, temperature etc. A more common term molar conductivity of a solution at a given concentration is conductance of the volume of solution containing one mole of electrolyte kept between two electrodes with the unit area of cross-section and distance of unit length. Limiting molar conductivity of weak electrolytes cannot be obtained graphically.



OR

- Is silver plate the anode or cathode?
- What will happen if the salt bridge is removed?
- When does electrochemical cell behaves like an electrolytic cell?
- (i) What will happen to the concentration of Zn^{2+} and Ag^+ when $E_{cell} = 0$.
(ii) Why does conductivity of a solution decreases with dilution?

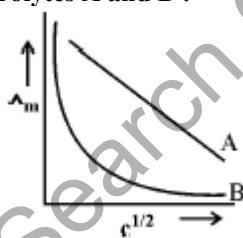
OR

- The molar conductivity of a 1.5 M solution of an electrolyte is found to be $138.9 \text{ cm}^2 \text{ mol}^{-1}$. Calculate the conductivity of this solution.

CBSE-2022

Section-E : Long Answer

- (a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes $FeSO_4$ and $ZnSO_4$ until 2.8 g of Fe deposited at the cathode of cell X. How long did the current flow? Calculate the mass of Zn deposited at the cathode of cell Y.
(Molar mass : Fe = 56 g mol^{-1} Zn = 65.3 g mol^{-1} , $1F = 96500 \text{ C mol}^{-1}$)
(b) In the plot of molar conductivity (Λ_m) vs square root of concentration ($c^{1/2}$), following curves are obtained for two electrolytes A and B :



Answer the following :

- Predict the nature of electrolytes A and B.
- What happens on extrapolation of Λ_m to concentration approaching zero for electrolytes A and B ?

CBSE-2019

- a) What are Galvanic cells? Explain the working of a Galvanic cell by taking Daniel cell as example.
- A galvanic cell is made by combining zinc-zinc sulphate ($E^\circ = -0.76 \text{ V}$) and copper-copper sulphate ($E^\circ = +0.34 \text{ V}$) electrodes.
(i) Write the cell notation of the cell.

- Identify the cathode and the anode in this cell.
- Which electrode is the positive electrode and which one is the negative electrode in this cell?
- Write the anodic reaction, cathodic reaction and the cell reaction.

NIOS Board-2022

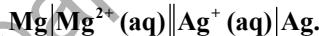
- Write the equations for the reactions taking place at anode and Cathode in the lead storage battery.
- Calculate the value of ΔrG° at 298K for the cell reaction.
$$3Mg(s) + 2Al^{+3} \rightarrow 2Mg^{2+}(aq) + 2Al(s)$$

Karnataka Board-2019

- The electrode potential for the Daniel cell given below is 1.1 V $Zn(s)|Zn^{2+}(aq)||Cu^{2+}(aq)|Cu(s)$. Write overall cell reaction and calculate the standard Gibb's energy for the reaction. [$F = 96487 \text{ C/mol}$]
b) Mention any two factors which affect the conductivity of electrolytic solution.

Karnataka Board-2017

- Write cell reaction and calculate electrical work obtained from the following galvanic cell at standard condition :



[Given

$$E_{Mg^{2+}/Mg}^\circ = -2.36 \text{ volt} \quad E_{Ag^+/Ag}^\circ = 0.80 \text{ volt.}]$$

West Bengal Board-2019

- The potential of the given following cell is 0.092 volt , at 298 K temperature. Calculate the pH of HCl solution ($E_{Sn|Sn^{2+}}^\circ = +0.14 \text{ volt}$)
$$\Theta Sn|Sn^2(0.05M)\parallel H^x(xM)|H_2(g)(1\text{bar})|Pt$$

Gujarat Board-2018

C. Nernst Equation

Section-A : Multiple Choice Questions

- At 298 k temperature, in Nernst equation 0.059 value is of—
(a) $\frac{RT}{2.303F}$ (b) $\frac{2.303RT}{F}$
(c) $\frac{RT}{F}$ (d) $\frac{2.303R}{TF}$

Gujarat Board-2021

Ans. (b)

- For the given cell reaction:
 $Mg/Mg^{2+}\parallel Cu^{2+}/Cu:$
(a) Mg as Cathode (b) Cu as Cathode
(c) Cu is oxidizing agent (d) None of the above

Haryana Board-2017

Ans. (b)

15.	Calculate the time to deposit 1.27 g of copper at cathode when a current of 2 A was passed through the solution of CuSO_4 . (Molar mass of Cu = 63.5 g mol ⁻¹), (1 F = 96500 C mol ⁻¹)	2.	(a) State Kohlraush's Law. (b) Calculate the electromotive force (e.m.f) of the following cell at 25°C- $\text{Zn} \text{Zn}^{2+}(0.01\text{M}) \text{Ag}^+(1.0\text{M}) \text{Ag}$ $E_{\text{cell}}^{\theta} = 1.56\text{V}$ (at 25°C) Uttarakhand Board 2023
16.	Using the E° values of A and B predict which is better for coating the surface of iron $[E_{(\text{Fe}^{2+}/\text{Fe})}^{\circ} = -0.44]$ to prevent corrosion and why? $E_{(\text{A}^{2+}/\text{A})}^{\circ} = 0.14\text{V}$ $E_{(\text{B}^{2+}/\text{B})}^{\circ} = 0.14\text{V}$	3.	Write the Nernst equation and calculate emf of the following cell at 298 K: $\text{Zn} \text{Zn}^{2+}(0.1\text{M}) \text{Cd}^{2+}(0.01) \text{Cd}$ Given, $E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = -0.76\text{V}$ $E_{\text{Cd}^{2+}/\text{Cd}}^{\circ} = -0.40\text{V}$ $(\log 10 = 1)$ CBSE-2022
17.	Express the relation among the conductivity of a solution in the cell, the cell constant and the resistance of solution in the cell.	4.	Write the Nernst equation and calculate emf of the following cell at 298 K: $\text{Zn} \text{Zn}^{2+}(0.001\text{M}) \text{H}^+(0.01\text{M}) \text{H}_2(\text{g})(1\text{bar}) \text{Pt}(\text{s})$ Given, $E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = -0.76\text{V}$ $E_{\text{H}^{+}/\text{H}_2}^{\circ} = 0.00\text{V}$ $[\log 10 = 1]$ CBSE-2022
18.	Calculate the emf for the given cell at 25°C. $\text{Cr} \text{Cr}^{3+}(0.1\text{M}) \text{Fe}^{2+}(0.01\text{M}) \text{Fe}$ [Given, $E_{\text{Cr}^{3+}/\text{Cr}}^{\circ} = -0.74\text{V}$, $E_{\text{Fe}^{2+}/\text{Fe}}^{\circ} = -0.44\text{V}$]	5.	Calculate the emf of the following cell : $\text{Zn}(\text{s}) \text{Zn}^{2+}(0.01\text{M}) (\text{0.001 M})\text{Ag}^+ \text{Ag}(\text{s})$ Given : $E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = +0.76\text{ V}$ and $E_{\text{Ag}^+/\text{Ag}}^{\circ} = +0.80\text{ V}$ $[\log 2 = 0.3010, \log 3 = 0.4771, \log 10 = 1]$ CBSE-2022
19.	(a) For the reaction $2\text{AgCl}(\text{s}) + \text{H}_2(\text{g}) (1\text{ atm}) \longrightarrow 2\text{Ag}(\text{s}) + 2\text{H}^+(0.1\text{ M}) + 2\text{Cl}^-(0.1\text{ M}),$ $\Delta G^{\circ} = -43600\text{ J}$ at 25°C. Calculate the e.m.f. of the cell. $[\log 10^{-n} = -n]$ (b) Define fuel cell and write its two advantages	6.	E _{cell} [°] for the given redox reaction is 2.71 V. $\text{Mg}_{(\text{s})} + \text{Cu}^{2+}(0.01\text{M}) \longrightarrow \text{Mg}^{2+}(0.001\text{M}) + \text{Cu}_{(\text{s})}$ Calculate E _{cell} for the reaction. Write the direction of flow of current when an external opposite potential applied is (i) less than 2.71 V and (ii) greater than 2.71 V CBSE-2019
20.	Calculate the E.M.F. of the cell $\text{Mg}(\text{s}) \text{Mg}^{2+}(0\times 1\text{M}) \text{Ag}^+(1\times 10^4\text{M}) \text{Ag}(\text{s})$ $E_{\text{Ag}/\text{Ag}^+}^{\circ} = +0.8\text{V}, E_{\text{Mg}^{2+}/\text{Mg}}^{\circ} = -2.37\text{V}$	7.	E _{cell} [°] for the given redox reaction is 2.71 V. $\text{Mg}_{(\text{s})} + \text{Cu}^{2+}(0.01\text{M}) \longrightarrow \text{Mg}^{2+}(0.001\text{M}) + \text{Cu}_{(\text{s})}$ Calculate E _{cell} for the reaction. Write the direction of flow of current when an external opposite potential applied is (i) less than 2.71 V and (ii) greater than 2.71 V CBSE-2019
21.	Write the Nernst equation for following cell : $\text{Sn}(\text{s}) \text{Sn}^{2+} \text{H}^+ \text{H}_2(\text{g})(1\text{bar}) \text{Pt}(\text{s})$	8.	(a) Calculate the E _{cell} [°] for the following cell reaction at 25°C : $\text{A} + \text{B}^{2+}(0.001\text{M}) \rightarrow \text{A}^{2+}(0.0001\text{M}) + \text{B}$ Given $E_{\text{cell}}^{\theta} = 2.6805\text{ V}$, $1\text{ F} = 96500\text{ C mol}^{-1}$ (b) Account for the following : (i) The cell potential of mercury cell remains constant throughout its life. (ii) Aluminium metal cannot be obtained by the electrolysis of an aqueous solution of salt of Aluminium.
22.	Calculate the equilibrium constant for the following cell at 25°C: $\text{Ni} \text{Ni}^{2+}(\text{aq}) \text{Ag}^+(\text{aq}) \text{Ag}$ Given, $E_{\text{Ni}^{2+}/\text{Ni}}^{\circ} = -0.25\text{V}$, $E_{\text{Ag}^+/\text{Ag}}^{\circ} = 0.80\text{V}$		CBSE-2019
23.	Write Nernst equation for Daniel cell.		
24.	Draw a neat labelled diagram of Standard Hydrogen Electrode (SHE). Write its Half-Cell Reaction.		
	Section-C : Short Answer		
1.	Calculate the value of ΔG° at 298 K for the cell reaction. $\text{Mg}_{(\text{s})} + \text{Cu}^{2+}_{(\text{aq})} \rightarrow \text{Mg}^{2+}_{(\text{aq})} + \text{Cu}_{(\text{s})}$ Given : $E_{\text{Mg}^{2+}/\text{Mg}}^{\circ} = -2.37\text{V};$ $E_{\text{Cu}^{2+}/\text{Cu}}^{\circ} = +0.34\text{ V}$ and $F = 96500\text{ C}$.	79	CBSE-2019

9. Use the data to answer the following and also justify giving reason :

	Cr	Mn	Fe	Co
$E^\circ_{M^{2+}/M}$	-0.91	-1.18	-0.44	-0.28
$E^\circ_{M^{3+}/M^{2+}}$	-0.41	+1.57	+0.77	+1.97

- (a) Which is a stronger reducing agent in aqueous medium, Cr^{2+} or Fe^{2+} and why ?
 (b) Which is the most stable ion in +2 oxidation and why ?

CBSE-2019

10. (a) Following reaction takes place in the cell :
 $\text{Zn}(\text{s}) + \text{Ag}_2\text{O}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{Ag}(\text{s}) + 2\text{OH}^-(\text{aq})$

Calculate $\Delta_r G^\circ$ of the reaction.

[Given : $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$,

$E^\circ_{(\text{Ag}^+/\text{Ag})} = 0.80 \text{ V}$, $1 \text{ F} = 96,500 \text{ C mol}^{-1}$]

- (b) How can you determine limiting molar conductivity, (Λ_m°) for strong electrolyte and weak electrolyte ?

CBSE-2019

11. A cell is constructed by dipping a zinc rod in 0.1 M zinc nitrate solution and a lead rod in a 0.2 M lead nitrate solution.

$E^\circ_{\text{Pb}^{2+}/\text{Pb}} = -0.13 \text{ V}$ and $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$

- (i) Write the spontaneous cell reaction.

- (ii) Calculate standard emf and emf of the cell.
 ISC Board-2004

12. For the cell

$\text{Zn}|\text{Zn}^{2+}(\alpha=1)|\text{Cu}^{2+}(\alpha=1)|\text{Cu}$

Given that, $E^\circ_{\text{Zn}/\text{Zn}^{2+}} = -0.76 \text{ V}$

$E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.339 \text{ V}$

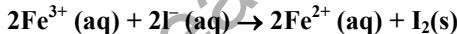
- (i). Write the cell reaction.

- (ii). Calculate the emf and free energy change at 298 K involved in the cell.

(Faraday's constant equivalent⁻¹)

ISC Board-2017, 2005

13. (i) The cell in which the following reaction occurs:



has $E^\circ_{\text{cell}} = 0.236 \text{ V}$ at 298 K.

Calculate the standard Gibbs energy of the cell reaction.

(Given, $1 \text{ F} = 96500 \text{ C mol}^{-1}$)

- (ii) How many electrons flow through a metallic wire if a current of 0.5 A is passed for 2 h?

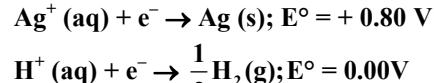
(given, $1 \text{ F} = 96500 \text{ C mol}^{-1}$)

All India 2017

14. Silver is uniformly electrodeposited on a metallic vessel of surface area of 900 cm^2 by passing a current of 0.5 A for 2 h. Calculate the thickness of silver deposited. Given, the density of silver is 10.5 g cm^{-3} and atomic mass of Ag = 108 amu.

All India 2013

15. (i) Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution:
 $\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s}) ; E^\circ = +0.80 \text{ V}$

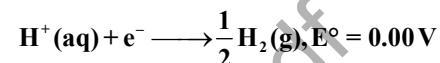
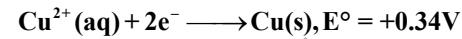


On the basis of their standard reduction electrode potential E° values, which reaction is feasible at the cathode and why?

- (ii) Define limiting molar conductivity. Why conductivity of an electrolyte solution decreases with the decrease in concentration?

Delhi 2015

16. (i) Following reactions occur at cathode during the electrolysis of aqueous copper (II) chloride solution.



On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why?

- (ii) State Kohlrausch's law of independent migration of ions. Write its one application.

Foreign 2015

17. Set-up Nernst equation for the standard dry cell. Using this equation show that the voltage of a dry cell decreases with use.

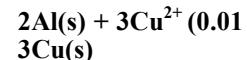
All India 2014C

18. A solution of $\text{Ni}(\text{NO}_3)_2$ is electrolysed between platinum electrodes using a current of 5.0 A for 20 min. What mass of nickel will be deposited at the cathode?

(Given : Atomic mass of Ni = 58.7 g mol^{-1} , $1 \text{ F} = 96500 \text{ C mol}^{-1}$)

Foreign 2014

19. (i) Calculate E°_{cell} for the following reaction at 298 K:



Given, $E^\circ_{\text{cell}} = 1.98 \text{ V}$

- (ii) Using the E° values of A and B, predict which is better for coating the surface of iron

$[E^\circ(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}]$ to prevent corrosion and why?

Given: $E^\circ(\text{A}^{2+}/\text{A}) = -2.37 \text{ V}$,

$E^\circ(\text{B}^{2+}/\text{B}) = -0.14 \text{ V}$

Delhi 2016

20. (i) The conductivity of 0.001 mol L^{-1} solution of CH_3COOH is $3.905 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation (α). Given,

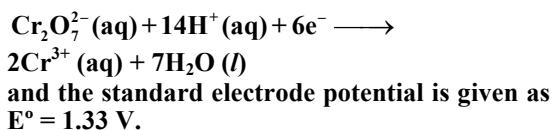
$$\lambda^\circ(\text{H}^+) = 349.6 \text{ Scm}^2 \text{ mol}^{-1}$$

$$\lambda^\circ(\text{CH}_3\text{COO}^-) = 40.9 \text{ Scm}^2 \text{ mol}^{-1}$$

- (ii) Define electrochemical cell. What happens if external potential applied becomes greater than E°_{cell} of electrochemical cell?

All India 2016

21. (i) Define the term degree of dissociation. Write an expression that relates the molar conductivity of a weak electrolyte to its degree of dissociation.
(ii) For the cell reaction,
 $\text{Ni(s)} \mid \text{Ni}^{2+}(\text{aq}) \parallel \text{Ag}^+(\text{aq}) \mid \text{Ag(s)}$ Calculate the equilibrium constant at 25°C.
How much maximum work would be obtained by operation of this cell?
 $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = 0.25\text{V}$ and $E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}$
- Delhi 2015C
22. (i) Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.
(ii) Calculate the standard cell potential of the galvanic cell in which the following reaction takes place:
 $\text{Fe}^{2+}(\text{aq}) + \text{Ag}^+(\text{aq}) \rightarrow \text{Fe}^{3+}(\text{aq}) + \text{Ag(s)}$
Calculate the $\Delta_r G^\circ$ and equilibrium constant of the reaction also.
 $E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}; E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.77\text{V}$
- All India 2015C
23. (i) Define molar conductivity of a solution and explain how molar conductivity changes with change in concentration of solution for a weak and a strong electrolyte.
(ii) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω . What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is $0.146 \times 10^{-3} \text{ S cm}^{-1}$?
- Delhi 2012, 2009, 2008; all India 2008
24. Conductivity of 0.00241 M acetic acid solution is $7.896 \times 10^{-5} \text{ Scm}^{-1}$. Calculate its molar conductivity in this solution. If Λ_m° for acetic acid be $390.5 \text{ Scm}^2 \text{ mol}^{-1}$, what would be its dissociation constant?
- Delhi 2008; All India 2008
25. Calculate the standard electrode potential of $\text{Ni}^{2+} \parallel \text{Ni}$ electrode if emf of the cell, $\text{Ni(s)} \mid \text{Ni}^{2+}(0.1\text{M}) \parallel \text{Cu}^{2+}(0.1\text{M}) \mid \text{Cu(s)}$ is 0.059 V. (Given, $(E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V})$.)
- Delhi 2009C
26. Calculate the emf of the following cell at 298 K.
 $2\text{Cr(s)} + 3\text{Fe}^{2+}(0.1\text{M}) \longrightarrow 2\text{Cr}^{3+}(0.01\text{M}) + 3\text{Fe(s)}$
Given,
 $E^\circ_{(\text{Cr}^{3+}/\text{Cr})} = -0.74\text{V}, E^\circ_{(\text{Fe}^{2+}/\text{Fe})} = -0.44\text{V}$
- Delhi 2016
27. Calculate the emf of the following cell at 25°C.
 $\text{Fe} \mid \text{Fe}^{2+}(0.001 \text{ M}) \parallel \text{H}^+(0.01 \text{ M}) \mid \text{H}_2(\text{g}) \text{ (1 bar)} \mid \text{Pt(s)}$
 $E^\circ_{(\text{Fe}^{2+}/\text{Fe})} = -0.44\text{V}; E^\circ_{(\text{H}^+/\text{H}_2)} = 0.00\text{V}$
- Delhi 2015
28. Calculate the emf of the following cell at 25°C.
 $\text{Zn} \mid \text{Zn}^{2+}(0.001\text{M}) \parallel \text{H}^+(0.01 \text{ M}) \mid \text{H}_2(\text{g}) \text{ (1 bar)} \mid \text{Pt(s)}$
 $E^\circ_{(\text{Zn}^{2+}/\text{Zn})} = -0.76\text{V}; E^\circ_{(\text{H}^+/\text{H}_2)} = 0.00\text{V}$
- Foreign 2015
29. Calculate the emf of the following cell at 298 K.
 $\text{Fe(s)} \mid \text{Fe}^{2+}(0.001\text{M}) \parallel \text{H}^+(1\text{M}) \mid \text{H}_2(\text{g}) \text{ (1 bar)} \mid \text{Pt(s)}$
[Given, $E^\circ_{\text{cell}} = +0.44 \text{ V}$]
- Delhi 2013
30. Calculate the emf of the following cell at 25°C.
 $\text{Ag(s)} \mid \text{ag}^+(10^{-3} \text{ M}) \parallel \text{Cu}^{2+}(10^{-1}\text{M}) \mid \text{Cu(s)}$
[Given, $\Delta E^\circ_{\text{cell}} = +0.46 \text{ V}$ and $\log 10^n = n$]
- All India 2013
31. A strip of nickel metal is placed in a 1 molar solution of $\text{Ni}(\text{NO}_3)_2$ and a strip of silver metal is placed in a one molar solution of AgNO_3 . An electrochemical cell is created when the two solutions are connected by a salt bridge and the two strips are connected by wires to a voltameter.
(i) Write the balanced equations for the overall reactions occurring in the cell and calculate the cell potential.
(ii) Calculate the cell potential, E, at 25°C for the cell, if the initial concentration of $\text{Ni}(\text{NO}_3)_2$ is 0.100 molar and the initial concentration of AgNO_3 is 1.00 molar.
 $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25\text{V}, E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}, \log 10^{-1} = -1$
- Foreign 2012
32. In the button cell, widely used in watches, the following reaction takes place,
 $\text{Zn(s)} + \text{Ag}_2\text{O(s)} + \text{H}_2\text{O(l)} \longrightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{Ag(s)} + 2\text{OH}^-(\text{aq})$
Determine E° and ΔG° for the reaction.
Given, $[E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}, E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}]$
- Delhi 2012
33. A voltaic cell is set up at 25°C with the following half-cells.
 $\text{Al} \mid \text{Al}^{3+}(0.001\text{M})$ and $\text{Ni} \mid \text{Ni}^{2+}(0.50 \text{ M})$
Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.
 $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25\text{V}$ and $(\log 8 \times 10^{-6} = -5.0969)$
- All India 2012, 2009;
Foreign 2011; Delhi 2009
34. Determine the values of equilibrium constant (K_C) and ΔG° for the following reaction,
 $\text{Ni(s)} + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Ni}^{2+}(\text{aq}) + 2\text{Ag(s)}$
 $E^\circ = 1.05 \text{ V}, (1 \text{ F} = 96500 \text{ C mol}^{-1})$
- HOTS; Delhi 2011; foreign 2011
35. Calculate the potential for half-cell containing 0.10 M $\text{K}_2\text{Cr}_2\text{O}_7$ (aq), 0.20 M Cr^{3+} (aq) and $1.0 \times 10^{-4} \text{ M H}^+$ (aq).
The half-cell reaction is



All India 2011

36. For the cell,
 $\text{Zn(s)} | \text{Zn}^{2+}(2\text{M}) \parallel \text{Cu}^{2+}(0.5 \text{ M}) | \text{Cu(s)}$
 (i) Write the equation for each half reaction.
 (ii) Calculate the cell potential at 25°C .
 [Given, $E_{\text{Zn}^{2+}/\text{Zn}}^\circ = -0.76 \text{ V}$, $E_{\text{Cu}^{2+}/\text{Cu}}^\circ = +0.34 \text{ V}$]

Delhi 2011C

37. Calculate the equilibrium constant, K, for the reaction at 298 K .
 $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightleftharpoons \text{Zn}^{2+}(\text{aq}) + \text{Cu(s)}$
 $\Delta G^\circ = -212.300 \text{ kJ mol}^{-1}$
 [Given, $E_{\text{Zn}^{2+}/\text{Zn}}^\circ = -0.76 \text{ V}$, $E_{\text{Cu}^{2+}/\text{Cu}}^\circ = +0.34 \text{ V}$]

All India 2011C

38. Write the Nernst equation and compute the emf of the following cell at 298 K .
 $\text{Sn(s)} | \text{Sn}^{2+} || \text{H}^+ | \text{H}_2, 1 \text{ atm} | \text{Pt}$
 $(0.05 \text{ M}) \quad (0.02 \text{ M})$
 [$E_{\text{Sn}^{2+}/\text{Sn}}^\circ = -0.144 \text{ V}$]

All India 2011C

39. A copper-silver cell is set up. The copper ion concentration is 0.10 M .
 The concentration of silver ion is not known. The cell potential when measured was 0.422 V . Determine the concentration of silver ions in the cell.
 [Given, $E_{\text{Ag}^+/\text{Ag}}^\circ = +0.80 \text{ V}$, $E_{\text{Cu}^{2+}/\text{Cu}}^\circ = +0.34 \text{ V}$]

Delhi 2010; All India 2009

40. One half-cell in a voltaic cell is constructed from a silver wire dipped in silver nitrate solution of unknown concentration. The other half-cell consists of a zinc electrode in a 0.10 M solution of $\text{Zn}(\text{NO}_3)_2$. A voltage of 1.48 V is measured for this cell.
 Use this information to calculate the concentration of silver nitrate solution.
 [Given, $E_{\text{Zn}^{2+}/\text{Zn}}^\circ = -0.763 \text{ V}$, $E_{\text{Ag}^+/\text{Ag}}^\circ = +0.80 \text{ V}$]

HOTS; Foreign 2010; Delhi 2009

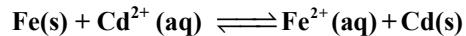
41. Calculate the emf of the cell in which the following reaction takes place,
 $\text{Ni(s)} + 2\text{Ag}^+(0.002\text{M}) \longrightarrow \text{Ni}^{2+}(0.160 \text{ M}) + 2\text{Ag(s)}$
 [Given that, $E_{\text{cell}}^\circ = 1.05 \text{ V}$]

Delhi 2010C

42. A voltaic cell is set-up at 25°C with the following half-cell.
 $\text{Ag}^+(0.001 \text{ M}) | \text{Ag and Cu}^{2+}(0.10 \text{ M}) | \text{Cu}$
 What would be the voltage of this cell?
 [Given, $E_{\text{cell}}^\circ = 0.46 \text{ V}$]

Delhi 2009; Foreign 2012

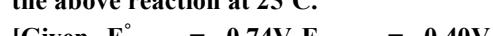
43. Calculate the equilibrium constant for the reaction.



[Given]

Delhi 2009; Foreign 2009

44. Calculate the standard cell potential of a galvanic cell in which the following reaction takes place.
 $2\text{Cr(s)} + 3\text{Cd}^{2+}(\text{aq}) \rightarrow 2\text{Cr}^{3+}(\text{aq}) + 3\text{Cd(s)}$
 Calculate $\Delta_r G^\circ$ and equilibrium constant, K, of the above reaction at 25°C .



[$1\text{F} = 96500 \text{ C mol}^{-1}$]

Delhi 2008C

45. (i) Formulate the electrochemical cell representing the reaction,
 $2\text{Cr(s)} + 3\text{Fe}^{2+}(\text{aq}) \longrightarrow 2\text{Cr}^{3+}(\text{aq}) + 3\text{Fe(s)}$
 (ii) Calculate E_{cell}° .
 (iii) Calculate E_{cell} at 25°C if
 $[\text{Cr}^{3+}] = 0.1 \text{ M}$ and $[\text{Fe}^{2+}] = 0.01 \text{ M}$
 [Given, $E_{\text{Cr}^{3+}/\text{Cr}}^\circ = -0.74 \text{ V}$, $E_{\text{Fe}^{2+}/\text{Fe}}^\circ = -0.44 \text{ V}$]

All India 2008C

46. (a) Write the differences between electronic and electrolytic conduction

Tamil Nadu Board-2015

47. (a) Write the cell reaction and calculate the e.m.f. of the following cell at 298 K :
 $\text{Sn(s)} | \text{Sn}^{2+}(0.004 \text{ M}) \parallel \text{H}^+(0.020 \text{ M}) | \text{H}_2(\text{g})(1 \text{ bar}) | \text{Pt(s)}$
 (Given: $E_{\text{Sn}^{2+}/\text{Sn}}^\circ = -0.14 \text{ V}$)
 (b) Give reasons :
 (i) On the basis of E° values, O_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaCl .
 (ii) Conductivity of CH_3COOH decreases on dilution.

UP Board-2018

48. Write the Nernst equation and calculate the emf of following cell at 298K :
 $\text{Ni/Ni}^{2+}(0.01\text{M}) \parallel \text{Cu}^{2+}/\text{Cu}(0.01\text{M})$
 Given $E^\circ(\text{Cu}^{2+}/\text{Cu}) = +0.34 \text{ V}$, $E^\circ(\text{Ni}^{2+}/\text{Ni}) = -0.22 \text{ V}$

Punjab Board-2017

49. What is salt bridge ? Mention its functions.

Jharkhand Board-2018

50. How many faradays of electricity are required to produce 13 g of aluminium from aluminium chloride solution?

(Given : Molar mass of Al = 27.0 g mol^{-1})

Maharashtra board-2018

51. How many moles of electrons are required for reduction of 2 moles of Zn^{2+} to Zn ? How many Faradays of electricity will be required ?

Maharashtra board-2022

52. (i) Daniel cell is represented as $Zn(s)/Zn^{2+}_{(aq)}//Cu^{2+}_{(aq)}/Cu(s)$. Write Nernst equation for Daniel cell.
(ii) The conductivity of 0.2 M solution of KCl at 298K is 0.0248 Scm^{-1} . Calculate its molar conductivity.
- Kerala Board-2021
53. You are supplied with the following substances Copper rod, Zinc rod, salt bridge, two glass beakers, a piece of wire, 1 M $CuSO_4$ solution, 1 M $ZnSO_4$ solution.
(a) Represent the cell made using the above materials.
(b) (i) Write the Nernst equation for the above cell.
(ii) Calculate the standard EMF of the cell if $E^\circ_{(Zn^{2+}/Zn)} = -0.76 \text{ V}$
 $E^\circ_{(Cu^{2+}/Cu)} = +0.34 \text{ V}$
- Kerala Board-2015
54. Calculate E°_{MF} of the following cell:
 $Cu | Cu^{2+} || Ag^+ | Ag$
Given is $E^\circ_{Cu^{2+}} | Cu = +0.34 \text{ V}$
 $E^\circ_{Ag^+ / Ag} = -0.80 \text{ V}$
- Haryana Board-2018
55. (a) Following reactions occur at cathode during the electrolysis of aqueous silver chloride.
 $Ag^+(aq) + e^- \rightarrow Ag(s) \quad E^\circ = +0.80 \text{ V}$
 $H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g) \quad E^\circ = 0.00 \text{ V}$
- On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why?
- Assam Board-2020
56. Depict the galvanic cell in which the reaction takes place. Further show, which of the electrode is negatively charged.
 $Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$
- Assam Board-2020
57. Write short notes on:
(i) Nernst equation
(ii) Corrosion
- MP Board-2013
- Section-E : Long Answer**
1. Calculate the emf and ΔG for the following cell
 $Mg(s) | Mg^{2+} (0.0001 \text{ M}) || Cu^{2+} (0.0001 \text{ M}) | Cu(s)$
 $E^\circ_{(Mg^{2+}/Mg)} = -2.37 \text{ V}, E^\circ_{(Cu^{2+}/Cu)} = 0.34 \text{ V}$
- Dehli 2015
2. Calculate the Δ_rG° and emf (E) that can be obtained from the following cell under the standard conditions at 25°C.
 $Zn(s) | Zn^{2+}(aq) || Sn^{2+}(aq) | Sn(s)$
[Given, $E^\circ_{Zn^{2+}/Zn} = -0.76$; $E^\circ_{Sn^{2+}/Sn} = -0.14 \text{ V}$
 $[F = 96500 \text{ C mol}^{-1}]$
- All India 2015C
3. (i) Write the formulation for the galvanic cell in which the reaction
 $Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$
takes place. identify the cathode and the anode reactions in it.
- (ii) Write the Nernst equation and calculate the emf of the following cell.
 $Sn(s) | Sn^{2+} (0.04 \text{ M}) || H^+ (0.02 \text{ M}) | H_2(g) | Pt(s) (1 \text{ bar})$
[Given $E^\circ_{Sn^{2+}/Sn} = -0.14 \text{ V}$]
- All India 2011C
4. Calculate the cell emf and Δ_rG° for the cell reaction at 25°C.
 $Zn(s) | Zn^{2+} (0.1 \text{ M}) || Cd^{2+} (0.01 \text{ M}) | Cd(s)$
[Given, $E^\circ_{Zn^{2+}/Zn} = -0.763 \text{ V}, E^\circ_{Cd^{2+}/Cd} = -0.403 \text{ V}$
 $1F = 96500 \text{ C mol}^{-1}, R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$]
- All India 2009C
5. Calculate the pH at which the potential of hydrogen electrode will be 0.059 V.
- Assam Board-2022
6. Write the Nernst equation and calculate potential of the following cells at 298k.
 $Mg_{(l)} / Mg^{2+} (0.001 \text{ M}) || Cu^{2+} (0.0001 \text{ M}) / Cu_{(s)}$
 $E^\circ_{Mg^{2+}/Mg} = -2.36 \text{ V} \text{ and } E^\circ_{Cu^{2+}/Cu} = 0.34 \text{ V}$
- Gujarat Board-2021
7. Write the characteristics of free energy G.
- Tamil Nadu Board-2011
8. (b) Derive Nernst equation
- Tamil Nadu Board-2011
9. (a) Write the cell reaction, Nernst equation and calculate the emf of the following cell : $Fe_{(l)} / Fe^{2+} (0.001 \text{ M}) || H^+ (1 \text{ M}) / H_{2(g)} (1 \text{ bar}) / Pt_{(s)}$
[Given : $E^\circ_{Fe^{2+}/Fe} = -0.44 \text{ V}$]
(b) Which cell was used as a power source in Apollo space program ? Write the chemical reactions taking place during anodic and cathodic processes. Mention two advantages of such cells.
- NIOS Board-2019
10. a) Calculate the e.m.f. of the cell in which the following reaction takes place.
 $Ni + 2Ag^+ (0.002 \text{ M}) \rightarrow Ni^{2+} (0.160 \text{ M}) + 2Ag_{(s)}$
Give $E^\circ_{\text{cell}} = 1.05 \text{ V}$.
- b) i) State Kohlrausch's law of Independent Migration of ions,
ii) What is meant by limiting molar conductivity?
- Karnataka Board-2020
11. a) Calculate e.m.f. of t cell for the reaction :
 $Mg_{(s)} + Cu^{2+} (0.0001 \text{ M}) \rightarrow Mg^{2+} (0.001 \text{ M}) + Cu_{(s)}$
Given that: $E^\circ_{Mg^{2+}/Mg} = -2.37 \text{ V}$
 $E^\circ_{Cu^{2+}/Cu} = +0.34 \text{ V}$
b) i) State Kohlrausch law.
ii) What is meant by limiting molar conductivity?
- Karnataka Board-2018
12. a) Calculate the EMF of the cell for the reaction
 $Mg_{(s)} + 2Ag^+ (aq) \longrightarrow Mg^{2+}_{(aq)} + 2Ag_{(s)}$
[Given : $E^\circ_{Mg^{2+}/Mg} = -2.37 \text{ V}, E^\circ$

$\text{Ag}^+/\text{Ag} = 0.80\text{V}$, $[\text{Mg}^{2+}] = 0.001\text{M}$, $[\text{Ag}^+] = 0.000\text{M}$ and $\log 10^5 = 5$.

b) What are fuel cells?

4 + 1

Karnataka Board-2015

13. (b) Derive Nernst equation.

Tamil Nadu Board-2018

14. Determine the standard emf of the cell and standard free energy change of the cell reaction $\text{Zn} \mid \text{Zn}^{2+} \mid \text{Ni}^{2+} \mid \text{Ni}$. The standard reduction potentials of Zn^{2+}/Zn and Ni^{2+}/Ni half cells are -0.76 V and -0.25 V respectively.

Tamil Nadu Board-2018

15. Write the Nernst equations and calculate EMF of the following cells at 298 K:

$\text{Fe(s)} \mid \text{Fe}^{2+}(0.001\text{M}) \parallel \text{H}^+(1\text{M}) / \text{H}_2(\text{g})(1\text{ bar}) / \text{pt(s)}$.

$$E^\circ_{\text{Fe}^{2+}, \text{Fe}} = -0.44\text{V}.$$

Haryana Board -2016

16. Write Nernst equation for Daniel cell at equilibrium condition and derive relationship between $E_{(\text{cell})}$ and equilibrium constant (K_e).

Rajasthan Board-2013

17. The potential of the given following cell is 0.46 V at 298 K temperature, calculate the pH of HCl solution. ($E^\circ_{\text{Cu/Cu}^{2+}} = -0.34\text{V}$)



Gujarat Board-2018

18. Calculate e.m.f of the following cell at 298 K: $2\text{Cr(s)} + 3\text{Fe}^{2+}(0.1\text{M}) \rightarrow 2\text{Cr}^{3+}(0.01\text{M}) + 3\text{Fe(s)}$

Given:

$$E^\circ_{(\text{Cr}^{3+}/\text{Cr})} = -0.74\text{V} \&$$

$$E^\circ_{(\text{Fe}^{2+}/\text{Fe})} = -0.44\text{V}$$

Assam Board-2019

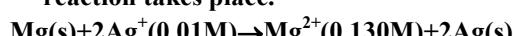
19. What type of a battery is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery.

Assam Board-2019

20. What is battery? Give one example each of primary battery and secondary battery.

Assam Board-2018

21. Represent the cell in which the following reaction takes place.

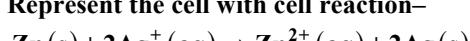


Write the Nernst equation and calculate the emf of the cell at 298K.

Given $E^\circ_{\text{cell}} = 3.17\text{V}$

Assam Board-2018

22. Represent the cell with cell reaction-

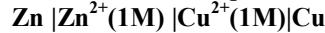


Calculate the emf of the cell at 298K if the molar concentrations of Ag^+ and Zn^{2+} ions in the half cells are 0.10 mol dm^{-3} and 0.01 mol dm^{-3} respectively.

Given that $E^\circ_{\text{Ag}^+/\text{ag}} = 0.80\text{V}$ and $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$.

Assam Board-2016

23. Write the Nernst equation for the cell:



Where $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$; $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$.

Write the reaction occurring at each of the electrode and its net cell reaction.

Also determine its cell potential.

Nagaland Board-2018

D. Conductance of Electrolytic Solutions

Section-A : Multiple Choice Questions

1. Non-electrolyte is

- (a) Sodium chloride
- (b) Urea
- (c) Ammonium nitrate
- (d) Nitric acid

UP Board 2023

Ans. (b)

2. Assertion (A) : Conductivity of an electrolyte increases with decrease in concentration.

Reason (R) : Number of ions per unit volume decreases on dilution.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
- (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
- (c) Assertion (A) is correct, but Reason (R) is wrong statement.
- (d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

Ans. (a)

3. Which of the following solutions of KCl will have the highest value of specific conductance ?

- (a) 0.5 M
- (b) 0.01 M
- (c) 0.1 M
- (d) 1.0 M

CBSE-2020

Ans. (d)

4. Kohlrausch given the following relation for strong electrolytes :

$$\kappa = \kappa_0 - A \sqrt{C}$$

Which of the following equality holds ?

- (a) $\kappa = \kappa_0$ as $C \rightarrow \sqrt{A}$
- (b) $\kappa = \kappa_0$ as $C \rightarrow \infty$
- (c) $\kappa = \kappa_0$ as $C \rightarrow 0$
- (d) $\kappa = \kappa_0$ as $C \rightarrow 1$

CBSE-2020

Ans. (c)

5. The unit of specific conductance is:

- (a) Ohm (b) cm
(c) cm^{-1} (d) $\text{Ohm}^{-1} \text{cm}^{-1}$

Odisha Board-2023

Ans. (d)

6. If l = length, R = Resistance and A = Area of cross section, then

- (a) $R = \frac{1}{Al}$ (b) $R = \frac{A}{l}$
(c) $R = \frac{l}{A}$ (d) $R = lA$

Gujarat Board-2019

Ans. (c)

7. The limiting molar conductivity of weak electrolytes can be calculated by using the law

- (a) Faraday's law (b) Kohlrausch law
(c) Henry's law (d) Raoult's law

Kerala Board-2020

Ans. (b) :

8. Conductance of an electrolytic solution depends:

- (a) Nature of electrolyte
(b) Power of AC source
(c) Distance between two electrodes
(d) None of the above

Haryana Board-2017

Ans. (a)

9. Which of the following does not change with dilution?

- (a) Specific conductance
(b) Conductance
(c) Equivalent conductance
(d) Molar conductance

Haryana Board-2016

Ans. (d)

10. Which is most basic?

- (a) Benzylamine (b) Aniline
(c) Acetamide (d) p-nitroaniline

Haryana Board-2016

Ans. (a)

11. The units of molar conductivity are:

- (a) $\text{ohm}^{-1} \text{m}^2 \text{mol}^{-1}$
(b) $\text{ohm} \text{m}^2 \text{mol}^{-1}$
(c) $\text{ohm}^{-1} \text{m}^2 \text{mol}$
(d) $\text{ohm}^{-2} \text{m}^2 \text{mol}^{-1}$

Haryana Board-2018

Ans. (a)

12. When sodium acetate is added to acetic acid, the degree of dissociation of acetic acid ____.

- (a) increases (b) decreases
(c) does not change (d) becomes zero

Tamilnadu Board, March-2016

Ans. (a)

13. On which factor the ionic conductivity of aqueous solution of an electrolyte does not depend?

(a) Pressure

(b) Temperature

(c) Concentration of electrolyte

(d) Nature of electrolyte

Gujarat Board-2016

Ans. (a)

14. The limiting molar conductivity and molar conductivity of acetic acid are $390.5 \text{ s cm}^2 \text{ mol}^{-1}$ and $48.15 \text{ s cm}^2 \text{ mol}^{-1}$ respectively. Calculate the degree of dissociation of the weak acid?

- (a) 12.33 (b) 0.1233
(c) 1.233 (d) 0.01233

Gujarat Board-2018

Ans. (b) :

15. For which compound graph of $\Lambda_m \rightarrow \sqrt{C}$ is not straight line?

- (a) MgCl_2 (b) KCl
(c) NaCl (d) ICN

Gujarat Board-2018

Ans. (d)

16. What is correct for $\Lambda_m^{\circ}(\text{NH}_4\text{OH})$?

- (a) $\Lambda_m^{\circ}(\text{NH}_4\text{Cl}) + \Lambda_m^{\circ}(\text{NaCl}) - \Lambda_m^{\circ}(\text{NaOH})$
(b) $\Lambda_m^{\circ}(\text{NH}_4\text{Cl}) + \Lambda_m^{\circ}(\text{NaOH}) - \Lambda_m^{\circ}(\text{NaCl})$
(c) $\Lambda_m^{\circ}(\text{NaOH}) + \Lambda_m^{\circ}(\text{NH}_4\text{Cl}) - \Lambda_m^{\circ}(\text{HCl})$
(d)

Gujarat Board-2019

Ans. (b)

17. On which of the following factor ionic conductivity of solution does not depend?

- (a) Concentration of electrolyte
(b) Nature of solvent
(c) Nature of electrolyte
(d) Size of molecules produce in solution

Gujarat Board-2019

Ans. (d)

18. $\Lambda_m^{\circ}(\text{NH}_4\text{OH})$ is equal to ____.

- (a) $\Lambda_m^{\circ}(\text{NH}_4\text{OH}) + \Lambda_m^{\circ}(\text{NH}_4\text{Cl}) - \Lambda_m^{\circ}(\text{HCl})$
(b) $\Lambda_m^{\circ}(\text{NH}_4\text{Cl}) + \Lambda_m^{\circ}(\text{NaCl}) - \Lambda_m^{\circ}(\text{NaOH})$
(c) $\Lambda_m^{\circ}(\text{NH}_4\text{OH}) + \Lambda_m^{\circ}(\text{NH}_4\text{OH}) - \Lambda_m^{\circ}(\text{NaCl})$
(d) $\Lambda_m^{\circ}(\text{NaOH}) + \Lambda_m^{\circ}(\text{NaCl}) - \Lambda_m^{\circ}(\text{NH}_4\text{Cl})$

Gujarat Board-2020

Ans: (d)*

19. The units of molar conductivity is:

- (a) $\text{ohm}^{-1} \text{cm}^2 \text{mol}^{-1}$ (b) $\text{ohm}^{-2} \text{cm} \text{mol}^{-2}$
(c) $\text{ohm}^{-2} \text{cm}^2 \text{mol}^{-1}$ (d) $\text{ohm}^{-1} \text{cm}^2 \text{mol}^{-2}$

Haryana Board-2016

Ans. (a)

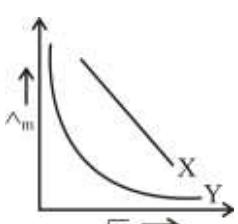
20. Unit of cell constant is:

- (a) $\text{ohm}^{-1} \text{cm}^{-1}$ (b) cm
(c) ohm cm (d) cm^{-1}

MP Board-2017

Ans. (0)

Section-B : Very Short Answer

1. Explain strong and weak electrolytes with examples. UP Board 2019
2. Explain the following :
 (i) Conductance
 (ii) Cell constant UP Board 2023
3. (i) Define Molar Conductivity.
 (ii) Graphically represent the variation of molar conductivity with concentration for strong and weak electrolytes. Kerala Board 2023
4. (a) Define colligative properties Manipur Board 2020
5. What is meant by 'limiting molar conductivity'? Manipur Board 2020
6. The conductivity of 2.5×10^{-4} M methanoic acid is 5.25×10^{-5} S cm⁻¹ and its Λ_m° has a value 400 S cm² mol⁻¹. Calculate its molar conductivity and degree of dissociation. CBSE-2022
7. In a plot Λ_m against the square root of concentration ($C^{1/2}$) for strong and weak electrolyte, the value of limiting molar conductivity of a weak electrolyte cannot be obtained graphically. Suggest a why to obtain this value. Also state the related law, if any. CBSE-2022
8. The conductivity of 0.001 M acetic acid is 7.8×10^{-5} S. Calculate its degree of dissociation if Λ°_m for acetic acid is 390 S cm² mol⁻¹. CBSE-2022
9. Define conductivity for the solution of an electrolyte. Why does the conductivity of a solution decrease with dilution? CBSE-2022
10. Define molar conductivity for the solution of an electrolyte. How does it vary with concentration. CBSE-2022
11. In the plot of molar conductivity (Λ_m) Vs. square root of concentration (\sqrt{C}), following curves are obtained for two electrolytes X and Y :
- 
- Answer the following :
 (i) Predict the nature of electrolyte X and Y.
- (ii) What happens on extrapolation of Λ_m to concentration approaching zero for electrolytes X and Y ? CBSE-2022
12. Define conductivity and molar conductivity for the solution of an electrolyte. Why does the conductivity of solution decrease with dilution ? CBSE-2019
13. (a) Resistance of a conductivity cell filled with 0.1 mol L⁻¹ KCl solution is 100 Ω. If the resistance of the same cell filled with 0.02 mol L⁻¹ KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.1 mol L⁻¹ KCl solution is 1.29 Sm⁻¹
 (b) Write the anode and cathode reactions that occur in mercury cell. CBSE-2019
14. Explain with a graph, the variation of molar conductivity of a strong electrolyte with dilution. CBSE-2019
15. (a) Write the reaction that occurs at anode on electrolysis of concentrated H₂SO₄ using platinum electrodes.
 (b) What is the effect of temperature on ionic conductance? CBSE-2019
16. Give a reason for the following :
 Specific conductance decreases with dilution whereas equivalent conductance increases with dilution. ISC Board-2007
17. The degree of dissociation of a weak electrolyte is.....proportional to the.....of its molar concentration. ISC Board-2006
18. As concentration of an electrolytic solution increases, its... conductance increases but.....conductance decreases. ISC Board-2003
19. Correct the following statement
 For a strong electrolyte, the plot of equivalent conductance versus concentration of the solution is a straight line. ISC Board-2002
20. Correct the following statement.
 On dilution of a solution, its equivalent and specific conductance increases. ISC Board-2001
21. Define molar conductance of a solution.
 State its unit. How is it related to the specific conductance of a solution ? ISC Board-2013
22. The conductivity of 0.2 M KCl solution is 3×10^{-2} ohm⁻¹ cm⁻¹. Calculate its molar conductance. ISC Board-2012
23. The unit of conductance is.....and that of specific conductance is ISC Board-2016

24. The molar conductance of a solution.... with dilution, while its specific conductance....with dilution.
ISC Board-2014
25. Kohlrausch's law is related to
ISC Board-2014
26. 0.3605 g of a metal is deposited on the electrode by passing 1.2 A of current for 15 min through a salt solution. The atomic weight of the metal is 96. What is the valency of metal ?
ISC Board-2014
27. A current of 4 A is passed through a molten solution for 45 min 2.977 g of metal is deposited. Calculate the charge carried by the metal cation if its atomic mass is 106.4 g/mol.
ISC Board-2002
28. How much electricity in terms of Faradays is required to produce 20 g of calcium from molten CaCl_2 ?
Delhi 2013C
29. What is meant by limiting molar conductivity?
All India 2010
30. Calculate the degree of dissociation (α) of acetic acid if its molar conductivity (Λ_m) is $39.05 \text{ S cm}^2 \text{ mol}^{-1}$.
Given: $\lambda^\circ(\text{H}^+) = 349.5 \text{ S cm}^2 \text{ mol}^{-1}$ and $\lambda^\circ(\text{CH}_3\text{COO}^-) = 40.9 \text{ S cm}^2 \text{ mol}^{-1}$
Delhi 2017
31. State Kohlrausch's law of independent migration of ions. Why does the conductivity of a solution decreases with dilution?
Delhi 2017
32. The conductivity of 0.001 M acetic acid is $4 \times 10^{-5} \text{ S cm}^{-1}$. Calculate the dissociation constant of acetic acid, if molar conductivity at infinite dilution for acetic acid is $390 \text{ S cm}^2 \text{ mol}^{-1}$.
Delhi 2013C
33. Express the relation among cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to its conductivity?
Delhi 2011, 2009, 2008; All India 2008
34. The molar conductivity of a 1.5 M solution of an electrolyte is found to be $138.9 \text{ S cm}^2 \text{ mol}^{-1}$. Calculate the conductivity of this solution.
All India 2012, 2010, 2009
35. State and explain Kohlrausch's law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch's law.
Delhi 2010; All India 2010C
36. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.
Delhi 2010C
37. Define molar conductivity of a substance and describe how for weak and strong electrolytes, molar conductivity changes with concentration of solute. How is such change explained?
Delhi 2009; Foreign 2009
38. The conductivity of a 0.20 M solution of KCl at 298 K is 0.0248 Scm^{-1} . Calculate its molar conductivity.
Delhi 2008
39. Illustrate with the help of a diagram how the molar conductivities of
(i) a strong electrolyte and
(ii) a weak electrolyte vary with dilution of solutions. Give a reason for these variations.
Delhi 2008C
40. Conductivity of $2.5 \times 10^{-4} \text{ M}$ methanoic acid is $5.25 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation.
Given: $\lambda^\circ(\text{H}^+) = 349.5 \text{ S cm}^2 \text{ mol}^{-1}$ and $\lambda^\circ(\text{HCOO}^-) = 50.5 \text{ S cm}^2 \text{ mol}^{-1}$.
All India 2015
41. The resistance of 0.01 M NaCl solution at 25°C is 200Ω . The cell constant of the conductivity cell used is unity. Calculate the molar conductivity of the solution.
All India 2014C
42. The value of Λ_m° of $\text{Al}_2(\text{SO}_4)_3$ is $858 \text{ S cm}^2 \text{ mol}^{-1}$, while $\lambda_m^\circ(\text{SO}_4^{2-})$ is $160 \text{ S cm}^2 \text{ mol}^{-1}$ calculate the limiting ionic conductivity of Al^{3+} .
All India 2013C
43. When a certain conductance cell was filled with 0.1 M KCl, it has a resistance of 85 ohms at 25°C . When the same cell was filled with an aqueous solution of 0.052 M unknown electrolyte, the resistance was 96 ohms. Calculate the molar conductance of the electrolyte at this concentration.
[Specific conductance of 0.1 M KCl = $1.29 \times 10^{-2} \text{ ohm}^{-1} \text{ cm}^{-1}$]
All India 2012C
44. The electrical resistance of a column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is $5.55 \times 10^3 \Omega$. Calculate its resistivity, conductivity and molar conductivity.
All India 2012
45. Calculate the degree of dissociation of acetic acid at 298 K , given that
 $\Lambda_m(\text{CH}_3\text{COOH}) = 11.7 \text{ S cm}^2 \text{ mol}^{-1}$
 $\Lambda_m^\circ(\text{CH}_3\text{COO}^-) = 40.9 \text{ S cm}^2 \text{ mol}^{-1}$
 $\Lambda_m^\circ(\text{H}^+) = 349.1 \text{ S cm}^2 \text{ Mol}^{-1}$
Delhi 2011C
46. Calculate Λ_m° for acetic acid,
Given that,
 $\Lambda_m^\circ(\text{HCl}) = 426 \text{ Scm}^2 \text{ mol}^{-1}$
 $\Lambda_m^\circ(\text{NaCl}) = 126 \text{ Scm}^2 \text{ mol}^{-1}$
 $\Lambda_m^\circ(\text{CH}_3\text{COONa}) = 91 \text{ Scm}^2 \text{ mol}^{-1}$
Delhi 2010
47. State and explain Kohlrausch's law of independent migration of ions. How can the degree of dissociation of acetic acid be calculated from its molar conductance data?
All India 2010, 2008C

48. The resistance of a conductivity cell when filled with 0.05 M solution of an electrolyte x is 100Ω at 40°C . The same conductivity cell filled with 0.01 M solution of electrolyte y has a resistance of 50Ω . The conductivity of 0.05 M solution of electrolyte x is $1.0 \times 10^{-4} \text{ S cm}^{-1}$
Calculate
 (i) cell constant.
 (ii) conductivity of 0.01 M solution.
 (iii) molar conductivity of 0.01 M solution
 All India 2008C
49. Express the relation between conductivity and molar conductivity of a solution held in a cell.
 Delhi 2011, 2008; All India 2008
50. Conductivity without resistance is called
 Chhattisgarh Board-2023
51. Define specific conductivity and molar conductivity. What is the effect of dilution on them?
 Odisha Board-2020
52. If the values of limiting molar conductivities of NaCl, HCl and CH₃COONa are 126.4, 425.9 and 91.05 S cm² mole⁻¹ respectively Then calculate the limiting molar conductivity of acetic acid.
 Gujarat Board-2016
53. What is superconductivity?
 Manipur Board-2018
54. Write the S.L unit of molar conductivity.
 Karnataka Board-2014
55. Draw a graph of $\lambda_m = \frac{V}{c}\sqrt{C}$ for acetic acid (weak electrolyte) solution.
 Karnataka Board-2019
56. Write the mathematical expression for limiting molar conductivity of sodium chloride (NaCl).
 Karnataka Board-2017
57. What happens to molar conductivity when one mole of KCl dissolved in one litre is diluted to five litres?
 Karnataka Board-2015
58. What is molar conductivity ? How is it related to conductivity of a solution whose concentration is C mol m⁻³?
 Karnataka Board-2014
59. (a) The molar conductance at infinite dilution for sodium Acetate (CH₃COONa), Hydrochloric Acid (HCl), and Sodium Chloride (NaCl) are 92.5, 426.9 and 120.4 S cm² mol⁻¹ respectively at 298 K. Calculate the molar conductance of Acetic Acid (CH₃COOH) at infinite dilution.
 (b) What is corrosion and give two factors which affect corrosion.
 Punjab Board-2019
60. (a) Calculate the molar conductance of a solution of MgCl₂ at infinite dilution given that the, molar ionic conductance of λ^0 (Mg²⁺) = 126.1 S cm² mol⁻¹ and λ^0 (Cl⁻) = 56.3 S cm² mol⁻¹.
- (b) Give two differences between E.M.F. and Potential difference.
 Punjab Board-2019
61. MnO₄⁻ → Mn⁺² for this reaction, how many Faraday are required?
 Haryana Board-2022
62. Write units of specific conductance.
 Haryana Board-2022
63. Distinguish between electronic conduction and electrolytic conduction.
 Jharkhand Board-2018
64. What is the effect of decrease in concentration on conductivity and molar conductivity?
 Karnataka Board-2020
65. λ_m^0 for NaCl, HCl and CH₃COONa are 126.4, 425.9 and 91.0 S cm² / mol respectively. Calculate λ_m^0 for CH₃COOH.
 Karnataka Board-2017
66. The molar conductivity of 0.05 M BaCl₂ solution at 25°C is $223 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$. What is its conductivity ?
 Maharashtra board-2019
67. Define conductance and give its unit.
 Jharkhand Board-2019
68. Which of the two is more basic, methylamine or NH₃?
 Chhattisgarh Board-2021
69. On dilution of a solution, its specific conductance—while its equivalent conductance—.
 ISC Board-2017
70. The law that can be used to determine the limiting molar conductivity (λ_m^0) of weak electrolytes is —
 Kerala Board-2022
71. What is the relationship between resistance and conductance. ?
 Kerala Board-2016
72. Write the definition of Kohlrausch law of independent migration of ions.
 Rajasthan Board-2017
73. Fill in the blanks :
 (a) The process of adding minute amount of impurity in an element or compound is called _____.
 MP Board-2018
74. What is an ionic conductance ?
 Nagaland Board-2021

Section-C : Short Answer

1. (a) The electrical resistance of a column of 0.05 M KOH solution of length 50 cm and area of cross-section 0.625 cm² is 5×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity.
 (b) Predict the products of electrolysis of an aqueous solution of CuCl₂ with platinum electrodes.

$$\left\{ \begin{array}{l} \text{Given : } E_{\text{Cu}^{2+}/\text{Cu}}^0 = +0.34 \text{ V}, E_{(\frac{1}{2}\text{Cl}_2/\text{Cl}^-)}^0 = +1.36 \text{ V} \\ E_{\text{H}^+/\text{H}_2(\text{g})\text{Pt}}^0 = 0.00 \text{ V}, E_{(\frac{1}{2}\text{O}_2/\text{H}_2\text{O})}^0 = +1.23 \text{ V} \end{array} \right.$$

CBSE-2020

2. Conductivity of 2×10^{-8} M methanoic acid is 8×10^{-5} S cm $^{-1}$. Calculate its molar conductivity and degree of dissociation if κ_m^0 for methanoic acid is 404 S cm 2 mol $^{-1}$.

CBSE-2020

3. (a) Out of the following pairs, predict with reason which pair will allow greater conduction of electricity:
 (i) Silver wire at 30°C or silver wire at 60°C
 (ii) 0.1 M CH₃COOH solution or 1 M CH₃COOH solution.
 (iii) KCl solution at 20°C or KCl solution at 50°C
 (b) Give two points of differences between electrochemical and electrolytic cells.

CBSE-2020

4. (a) The electrical resistance of a column of 0.05 mol L $^{-1}$ NaOH solution of diameter 1 cm and length 50 cm is 5.55×10^3 ohms. Calculate the resistivity, conductivity and molar conductivity. Given : $\pi = 3.14$
 (b) Given reasons:
 (i) Fuel cells are preferred for production of electrical energy than thermal plants.
 (ii) Iron does not rust even if zinc coating is broken in a galvanized pipe.

CBSE-2020

5. Answer the following questions (Any two) :
 (a) Define Molar Conductivity (κ_m).
 (b) Write the unit of κ_m .
 (c) How does κ_m vary with concentration ?

CBSE-2022

6. The resistance and conductivity of a conductivity cell containing 0.001 M KCl solution at 298 K are 1200 Ω and 1.5×10^{-4} S cm $^{-1}$. Calculate its cell constant and molar conductivity.

CBSE-2022

7. (a) The conductivity of 0.001 mol L $^{-1}$ acetic acid is 4.95×10^{-5} S cm $^{-1}$. Calculate the dissociation constant if κ_m^0 for acetic acid is 390.5 S cm 2 mol $^{-1}$.
 (b) Write Nernst equation for the reaction at 25°C :

$$2\text{Al(s)} + 3\text{Cu}^{2+}(\text{aq}) \rightarrow 2\text{Al}^{3+}(\text{aq}) + 3\text{Cu(s)}$$

 (c) What are secondary batteries? Give an example.

CBSE-2019

8. (a) The molar conductivity of 0.025 mol L $^{-1}$ methanoic acid is 46.1 S cm 2 mol $^{-1}$. Calculate its degree of dissociation and dissociation constant. Given $\kappa^0 \text{H}^+ = 349.6$

$$S \quad \text{cm}^2 \quad \text{mol}^{-1} \quad \text{and} \\ \kappa^0 \text{HCOO}^- = 54.6 \text{ S cm}^2 \text{mol}^{-1}$$

- (b) Account for the following :

- (i) The blue colour of copper sulphate solution is slowly discharged when a rod of zinc is dipped in it.
 (ii) Rusting becomes quicker in saline medium.

CBSE-2019

9. A solution of 0.1 N KCl offers a resistance of 245 Ω. Calculate the specific conductance and the equivalent conductance of the solution if the cell constant is 0.571 cm $^{-1}$.

ISC Board-2010

10. A 0.05 M NaOH solution offered a resistance of 31.6 Ω in a conductivity cell. If the cell constant of the conductivity cell is 0.378 cm $^{-1}$, determine the molar conductance of NaOH solution at this temperature.

ISC Board-2008

11. Calculate the equivalent conductivity of 1 M H₂SO₄ whose specific conductivity is 26×10^{-2} ohm $^{-1}$ cm $^{-1}$.

ISC Board-2006

12. 0.05 M NaOH solution offered a resistance of 31.6 Ω in a conductivity cell at 298 K. If the cell constant of the cell is 0.367 cm $^{-1}$, calculate the molar conductivity of the NaOH solution.

ISC Board-2014

13. State Kohlrausch's law and give its mathematical expression mentioning the terms involved in it.

ISC Board-2010

14. A conductivity cell has a cell constant of 0.5 cm $^{-1}$. This cell when filled with 0.01 M sodium chloride solution has a resistance of 384 Ω at 25°C. Calculate the equivalent conductivity of 0.01 M sodium chloride at 25°C.

ISC Board-2000

15. Specific conductivity of 0.20 M solution of KCl at 298 K is 0.025 S cm $^{-1}$. Calculate its molar conductivity.

ISC Board-2017

16. A 0.05 M NH₄OH solution offers the resistance of 50 Ω to a conductivity cell at 298 K. If the cell constant is 0.50 cm $^{-1}$, and molar conductance of NH₄OH at infinite dilution is 471.4 Ω $^{-1}$ cm 2 mol $^{-1}$. Calculate

- (i) Specific conductance
 (ii) Molar conductance
 (iii) Degree of dissociation

ISC Board-2016

17. A current of 10 A is passed for 80 min and 27 s through a cell containing dilute sulphuric acid.

- (i) How many moles of oxygen gas will be liberated at the anode?
 (ii) Calculate the amount of zinc deposited at the cathode when another cell containing ZnSO₄ solution is connected in series (Zn = 65)

ISC Board-2007

18. Given that, the standard electrode potentials (E°) of metals are
 $K^+ / K = -2.93 \text{ V}$, $Ag^+ / Ag = 0.80 \text{ V}$
 $Cu^{2+} / Cu = 0.34 \text{ V}$, $Mg^{2+} / Mg = -2.37 \text{ V}$
 $Cr^{3+} / Cr = -0.74 \text{ V}$, $Fe^{2+} / Fe = -0.44 \text{ V}$
Arrange these metals in an increasing order of their reducing power.
- All India 2010
19. Pure water is bad conductor of electricity while acidic water is a good conductor. Why ?
- Chhattisgarh Board-2023
20. (a) Differentiate between electronic conduction and electrolytic conduction.
- Tamil Nadu Board-2011
21. Define molar conductance. Mention its unit.
- Tamil Nadu Board-2016
22. (a) Define 'molar conductivity'. What is the molar conductivity ?unit of
(b) The concentration of a reactant in a first order reaction reduces from 0.5 M to 0.005 M in 20 minutes . Calculate the rate constant of the reaction.
- NIOS Board-2012
23. With decrease in concentration of an electrolytic solution, conductivity (K) decreases and molar conductivity (λ_m) increases.
(a) Write the equation showing the relationship between conductivity and molar conductivity.
(b) How will you account for the increase in molar conductivity with decrease in concentration?
(c) Limiting molar conductivity (λ_m^0) of a strong electrolyte can be determined by graphical extrapolation method. Suggest a method for the determination of limiting molar conductivity of a weak electrolyte taking acetic acid (CH_3COOH) as example.
- Kerala Board-2013
24. (a) What are conjugate acid-base pairs? Explain with example.
(b) Define molar conductivity. How is it related to conductivity?
- NIOS Board-2023
25. Explain Kohlrausch's law.
- J&K Board-2019
26. What is Kohlrausch's law? Explain its any two applications.
- Chhattisgarh Board-2021
27. Explain the redox reaction with example. Write the definition and unit of the specific conductance and molar conductance.
- Chhattisgarh Board-2021
28. Specific conductivity of 0.20 M solution M solution of KCl at 298 K is 0.025 S cm^{-1} Calculate its molar conductivity
- ISC Board-2017
29. Complete the table by giving the value of Van't Hoff factor 'i' for complete dissociation of solute.

Salt	Vant Hoff factor 'i' for complete dissociation of solute
$NaCl$
$Al(NO_3)_3$
K_2SO_4
$Al_2(SO_4)_3$

Kerala Board-2020

30. How much H_2 in grams will be liberated if 1F electricity is passed through acidified water?
- Assam Board-2014
31. Why does the conductivity of a solution decrease with dilution?
- Haryana Board-2017
32. The conductivity of 0.10M solution of KCl at 298K is 0.0129 s cm^{-1} . Calculate its molar conductivity.
- Rajasthan Board-2019
33. Write any two factors which affects the conductance of electrolysis.
- Rajasthan Board-2019
34. Copper shows electrical conductance in solid as well as molten state whereas copper chloride shows electrical conductance only in molten state. Give reason.
- Rajasthan Board-2018
35. If λ_m^0 for $NaCl$, and CH_3COOH are $110, 100$ and 390 mole^{-1} respectively. Determine the value of λ_m^0 for CH_3COONa .
- Rajasthan Board-2017
36. Write the SI unit of Resistivity.
- Rajasthan Board-2015
37. Limiting molar conductivities of Mg^{2+} and Cl^- ions are $106.0 \text{ s.cm}^2 \cdot mol^{-1}$ and $76.3 \text{ s.cm}^2 \cdot mol^{-1}$ respectively. Calculate the limiting molar conductivity of $MgCl_2$.
- Rajasthan Board-2015
38. Write Kohlrausch law and give one application of it.
- Rajasthan Board-2014
39. Classify salt, zinc, copper sulphate and graphite conductors into ionic and electronic conductors.
- Rajasthan Board-2010
40. What is the difference between molar conductance and equivalent conductance? Determine equivalent conductance of $BaCl_2$ if its molar conductance is $104 \text{ ohm}^{-1} \text{ cm}^2 \text{ mole}^{-1}$.
- Rajasthan Board-2010
41. Define Kohlraush's law.
- Tamilnadu Board, Sep.-2016
42. State Kohlraush's Law.
- Tamilnadu Board, March-2016
43. State Kohlrausch law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch law.
- Assam Board-2020
44. Define molar conductivity of a solution. Explain how molar conductivity changes with change in concentration of solution for a weak and a strong electrolyte.
- Assam Board-2020

45. What is meant by conductivity and resistivity? State their units.
Gujarat Board-2020
46. Define molar conductivity of an electrolytic solution. Show the variation of molar conductivity of a strong electrolyte with square root of concentration.
Assam Board-2017
47. Define molar conductivity of an electrolytic solution. How does molar conductivity vary with concentration for weak electrolyte?
Assam Board-2015
48. (a) How do you explain with the help of graph, the increase in the value of molar conductivity with dilution in case of strong and weak electrolyte?
(b) Calculate the emf of the cell at 298 K, in which the following reaction takes place:

$$\text{Ni(s)} + 2\text{Ag}^+(\text{aq}) \text{ (0.002 M)} \rightarrow \text{Ni}^{2+}(\text{aq}) \text{ (0.160 M)} + 2\text{Ag(s)}$$
 (Given that $E^\circ_{\text{cell}} = 1.05\text{V}$)
Assam Board-2013
49. The conductivity of 0.20M solution of KCl at 298K is 0.0248 Scm^{-1} ; Calculate its molar conductivity.
Assam Board-2012
50. Define the following and write the formula and unit of each :
 (i) Equivalent conductivity
 (ii) Molar conductivity
MP Board-2018
51. What is Kohlrausch's law? Explain any two applications of Kohlrausch's law.
MP Board-2015
52. Define equivalent conductivity and give its S.I. units.
J & K Board-2021
53. The following limiting molar conductivity are given as –
 $\lambda_m^0(\text{H}_2\text{SO}_4) = x \text{ Scm}^2 \text{ mol}^{-1}$
 $\lambda_m^0(\text{K}_2\text{SO}_4) = y \text{ S cm}^2 \text{ mol}^{-1}$
 $\lambda_m^0(\text{CH}_3\text{COOK}) = z \text{ S cm}^2 \text{ mol}^{-1}$
 Calculate limiting molar conductivity of acetic acid.
Assam Board-2023

Section-D : Case Based Study

1. The molar conductivities of NH_4^+ and Cl^- ion are $73.8 \text{ S cm}^2 \text{ mol}^{-1}$ and $76.2 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. The conductivity of 0.1 M NH_4Cl is $1.29 \times 10^{-2} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation.

Gujarat Board 2023 (July)

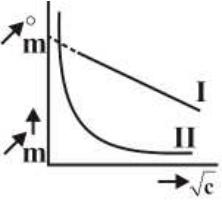
- Section-E : Long Answer**
1. (a) (i) Calculate emf of the following cell at 298K:
 $\text{Al(s)} | \text{Al}^{3+} \text{ (0.1M)} || \text{Cu}^{2+} \text{ (0.01M)} | \text{Cu(s)}$
 Given: $E^\circ_{\text{cell}} = 2.00\text{V} (\log 10 = 1)$
 (ii) Define molar conductivity. On dilution, why does the molar conductivity of HCOOH increase drastically, while that of HCOONa increases gradually?
CBSE-2021
2. (i) The electrical resistance of a column of 0.02 M NaOH solution of diameter 1.40 cm and length 44 cm is $5.00 \times 10^3 \text{ ohm}$. Calculate its resistivity, conductivity and molar conductivity.
 (ii) Depict the galvanic cell in which the reaction takes place:

$$\text{Ni(s)} + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Ni}^{2+}(\text{aq}) + 2\text{Ag(s)}$$

 Further show:
 (I) Which of the electrodes is positively charged?
 (II) The carriers of the current in the outer circuit.
CBSE-2021
3. (i) Define the following terms:
 (a) Limiting molar conductivity
 (b) Fuel cell
 (ii) Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100Ω . If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520Ω , calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. the conductivity of 0.1 mol L^{-1} KCl solution is $1.29 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$.
Delhi 2014
4. (i) Define the following terms:
 (a) Molar conductivity (Λ_m)
 (b) Secondary batteries
 (c) Fuel cell
 (ii) State the following laws:
 (a) Faraday's first law of electrolysis
 (b) Kohlrausch's law of independent migration of ions
Delhi 2015C
5. The molar conductance of 0.1 M aqueous solution of NH_4OH is $9.54 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$ and at infinite dilution molar conductance is $238 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$. Calculate the degree of ionization of ammonium hydroxide at the same concentration and temperature.
Assam Board-2022
6. (d) Ionic conductance at infinite dilution of Al^{3+} and SO_4^{2-} are $189 \text{ ohm}^{-1} \text{ cm}^2 \text{ gm}^{-1}$. Equiv $^{-1}$. and $160 \text{ ohm}^{-1} \text{ cm}^2 \text{ equiv}^{-1}$ Calculate equivalent and molar conductance of the electrolyte at infinite dilution.
Tamil Nadu Board-2015

7. (a) What is the effect of common ions on the dissociation of weak acids and weak bases? Define pH of a solution.
 (b) What is the relationship between molar conductivity and conductivity. Derive the unit of λ_m .
 (c) What is amphiprotic species? Name the amphiprotic species in the given reaction:

$$\text{HCO}_3^-(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{CO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(l)$$

$$\text{H}_2\text{CO}_3(\text{aq}) + \text{CN}^-(\text{aq}) \rightleftharpoons \text{HCO}_3^-(\text{aq}) + \text{HCN}(\text{aq})$$
- NIOS Board-2019
8. Variation of molar conductivity (λ_m) versus concentration (\sqrt{c}) for a strong and weak electrolytes are given below
- 
- (i) Identify I and II as strong and weak electrolytes.
 (ii) What does λ_m° indicate?
 (iii) Suggest a method to determine λ_m° for the electrolyte II.
- Kerala Board-2021
9. Give two differences between metallic and electrolytic conductors.
- Haryana Board-2017
10. What is Kohlrausch's Law? How does it help in calculation of λ for a weak electrolyte CH_3COOH ?
- Haryana Board-2016
11. What is relationship between specific conductance & equivalent conductance?
- Haryana Board-2016
12. Explain Kohlrausch law with a suitable example.
- Haryana Board-2018
13. At 298 K the conductivity of 0.20 M KCl solution is $0.02485 \text{ ohm}^{-1}\text{cm}^{-1}$. Calculate the molar conductivity of the solution.
- Haryana Board-2018
14. The resistances of 0.05 M NaOH solution is 31.6Ω and its cell constant is 0.357 cm^{-1} , Calculate its conductivity and molar conductivity.
- Haryana Board-2018
15. If the value of molar conductivities at infinite dilution for CH_3COOH , HCl and NaCl are 390.5, 425.4 and $126.4 \text{ S cm}^2 \text{ mol}^{-1}$ respectively at 298K. Calculate the molar conductivity at infinite dilution of CH_3COONa .
- Rajasthan Board-2020
16. Resistance of a conductivity cell with 0.15 mol L^{-1} NaCl solution is 50Ω . If resistance of the same cell when filled with 0.02 mol L^{-1} NaCl solution is 500Ω calculate the conductivity of 0.02 mol L^{-1} NaCl solution. (The conductivity of 0.15 mol L^{-1} NaCl solution is 1.5 s/m).
- Rajasthan Board-2016
17. The conductivity of 0.001 mol L^{-1} acetic acid is $5 \times 10^{-5} \text{ s cm}^{-1}$. Calculate it's dissociation constant if λ_m° for acetic acid is $250 \text{ s cm}^2 \text{ mol}^{-1}$?
- Rajasthan Board-2016
18. An electric current is passed through three cells in series containing solution of copper sulphate, silver nitrate and potassium iodide respectively. What weights of silver and iodine will be liberated while 1.25 g of copper is being deposited?
- Tamilnadu Board, March-2016
19. Discuss electrolytic conduction. What are factors on which it depends?
- Haryana Board-2016
20. State Kohlrausch law. The limiting molar conductances of NaCl, HCl and CH_3COONa are 126.45, 426.16 and $91.0 \text{ S cm}^2 \text{ mol}^{-1}$ respectively at 298K. Calculate limiting molar conductance of acetic acid at 298K.
- Assam Board-2017
21. A current of 0.5 ampere is passed for 30 minutes through a voltameter containing copper sulphate solution. Calculate the mass of Cu deposited at the cathode. Given that atomic mass of Cu is 63.0 amu.
- Assam Board-2016
22. The limiting molar conductances of sodium chloride, hydrochloric acid and sodium acetate are 126.45, 426.16 and $91.0 \text{ Scm}^2 \text{ mol}^{-1}$ respectively at 298K. Calculate the limiting molar conductance of acetic acid at 298K.
- Assam Board-2015
23. What is Kohlrausch laws give its any one applications.
- MP Board-2017
24. (i) What is specific conductivity? What is its relation with specific resistance? What is its unit?
 (ii) Write Ohm's law.
- MP Board-2014
25. Explain (Definition and Formula):
 (a) Kohlrausch's Law
 (b) Faraday's first law of electrolysis.
- MP Board-2012
26. Define the following and write the formula and unit of each:
 (a) Specific conductivity.
 (b) Molar conductivity.
- MP Board-2012
27. State and explain Faraday's second law of electrolysis.
- J & K Board-2021

11. Mention any two factors affecting the electrode potential of a metal.
ISC Board-2009
12. Copper displaces.....from its solution because it has a.....reduction potential.
ISC Board-2002
13. Correct the following statement.
Copper displaces both zinc and silver from their solutions.
ISC Board-2000
14. Will nickel displace copper from a 1 M solution of copper sulphate ? Justify your answer.
 $(E_{Ni^{2+}/Ni}^{\circ} = -0.25V, E_{Cu^{2+}/Cu}^{\circ} = +0.34V)$
ISC Board-2010
15. What is standard hydrogen electrode ?
ISC Board-2014
16. Two metallic elements A and B have the following standard potentials :
 $A = 0.40\text{ V}$, $B = 0.80\text{ V}$, what would you expect if element A was added to an aqueous salt solution of element B ? Give a reason for your answer.
ISC Board-2013
17. Arrange Ag, Cr and Hg metals in the increasing order of reducing power.
Given, $E_{Ag^{+}/Ag}^{\circ} = +0.80\text{ V}$
 $E_{Cr^{3+}/Cr}^{\circ} = -0.74\text{ V}$ and
 $E_{Hg^{2+}/Hg}^{\circ} = +0.79\text{ V}$
ISC Board-2013
18. Electrolysis follows.....
ISC Board-2009
19. (i) Calculate the mass of Ag deposited at cathode when a current of 2A was passed through a solution of $AgNO_3$ for 15 min.
(Given: Molar mass of Ag = 108 g mol^{-1} 1F = 96500 C mol^{-1}).
(ii) Define fuel cell.
Delhi 2017
20. Explain why electrolysis of aqueous solution of NaCl gives H_2 at cathode and Cl_2 at anode?
Write overall reaction.
Given, $E_{Na^{+}/Na}^{\circ} = 2.71\text{ V}$, $E_{H_2O/H_2}^{\circ} = -0.83\text{ V}$,
 $E_{Cl_2/Cl^-}^{\circ} = +1.36\text{ V}$ $E_{H^+/H_2/H_2O}^{\circ} = +1.23\text{ V}$
HOTS; Delhi 2009C; All India 2008C
21. How many moles of mercury will be produced by electrolyzing 10 M $Hg(NO_3)_2$ solution with a current of 2.00 A for three hours?
[$Hg(NO_3)_2 = 200.6\text{ g mol}^{-1}$]
All India 2011
22. In the electrolysis of aqueous sodium bromide, there are two possible anodic reactions.
 $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-, E^{\circ} = 1.23\text{ V}$
 $2Br^-(aq) \rightarrow Br_2(g) + 2e^-, E^{\circ} = 1.08\text{ V}$
Which reaction occurs at anode and why?
All India 2011C
23. State Faraday's second law of electrolysis.
Telangana Board-2023
24. At $25\text{ }^{\circ}\text{C}$, calculate the e.m.f of the cell $Z_{n(s)} | Z_n^{++}(0.1M) || C_u^{++}(0.01M) | Cu_{(s)}$.
Given,
 $E_{Z_n^{++}/Zn}^{\circ} = -0.76\text{ V}$, $E_{C_u^{++}/C_u}^{\circ} = 0.34\text{ V}$
Odisha Board-2023
25. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using a current of 5 amperes for 20 minutes. What mass of nickel is deposited at the cathode? [molar mass of Ni = $58.7\text{ gram mol}^{-1}$].
Karnataka Board-2020
26. In the extraction of Aluminium by Hall-Heroult process: (a) Write the neat labeled diagram of electrolytic cell. (b) Give the equation of overall cell reaction. (c) What is the role of cryolite?
Karnataka Board-2019
27. Draw a neat, labelled diagram of electrolytic cell for the extraction of aluminium.
Maharashtra board-2019
28. Explain the terms, Zeta potential, electrophoresis and electro-osmosis.
Kerala Board-2019
29. State the Faraday's laws of Electrolysis. [2]
(OR)
What is the difference between electromotive force (emf) and Potential Difference?
Uttarakhand Board-2019
30. Identify the product formed at the cathode during electrolysis of aqueous solution of $MgSO_4$?
Manipur Board-2022
31. Write Faraday's first law of electrolysis.
Rajasthan Board-2020
32. Give half cell equation of Daniel cell takes place at cathode.
Rajasthan Board-2017
33. Fill in the blanks :
(c) In lead storage cell _____ works as electrolyte.
MP Board-2018
34. State Faraday's 2nd law of Electrolysis.
J & K board-2023

Section-C : Short Answer

1. Define conductivity and molar conductivity of an electrolyte. What will be the effect of change in concentration on them? Explain.
UP Board 2019
2. With the help of graph explain why it is not possible to determine Λ_m° for a weak electrolyte by extrapolating the molar conductivity (Λ_m) versus $C^{1/2}$ curve as for strong electrolyte
Gujarat Board 2023 (July)

For Questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) true, but Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false

(d) Assertion (A) is false, but Reason (R) is true.

3. Assertion (A) : Limiting molar conductivity (Λ_m°) is obtained by the extrapolation of the Λ_m° versus $C^{1/2}$ curve of strong electrolyte.

Reason (R) : Λ_m° for weak electrolytes is obtained by using Kohlrausch's law.

Gujarat Board 2023 (July)

4. Explain Kolharasch law. Write in brief two applications of this law.

MP Board 2020

5. Λ_m° for NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 $\text{S} \text{ an}^2 \text{ mol}^{-1}$; respectively Calculate Λ_m° for CH_3COOH .

Kerala Board 2023

6. What is molar conductance? How is it related to concentration "C" mol m^{-3} and conductivity "K" Sm^{-1} ?

Karnataka board 2023

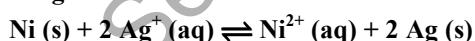
7. Mention any two applications of Kohlrausch law.

Karnataka board 2023

8. A solution of MgSO_4 is electrolysed to carry out deposition of 24.3g of magnesium at cathode. how many electrons pass through the solution during the process?

Manipur Board 2023

9. Calculate the maximum work and $\log K_c$ for the given reaction at 298 K :



Given :

$$E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V}, E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$$

$$1 \text{ F} = 96500 \text{ C mol}^{-1}$$

CBSE-2020

10. When a steady current of 2A was passed two electrolytic cells A and B containing electrolytes ZnSO_4 connected in series, 2 g of Cu were mass of Zn was deposited at cathode of cell A ?

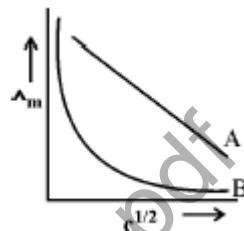
[Atomic mass : Cu = 63.5 g mol^{-1} , Zn = 65 g mol^{-1} , 1F = 96500 C mol^{-1}]

CBSE-2020

11. (a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes FeSO_4 and ZnSO_4 until 2.8 g of Fe deposited at the cathode of cell X. How long did the current flow? Calculate the mass of Zn deposited at the cathode of cell Y.

(Molar mass : Fe = 56 g mol^{-1} Zn = 65.3 g mol^{-1} , 1F = 96500 C mol^{-1})

- (b) In the plot of molar conductivity (Λ_m°) vs square root of concentration ($C^{1/2}$), following curves are obtained for two electrolytes A and B :



Answer the following :

- (i) Predict the nature of electrolytes A and B.
(ii) What happens on extrapolation of Λ_m° to concentration approaching zero for electrolytes A and B ?

CBSE-2019

12. An aqueous solution of copper sulphates, CuSO_4 was electrolysed between platinum electrodes using a current of 0.1287 A for 50 min.

[Given, atomic mass of Cu = 63.5 g mol^{-1}]

- (i) Write the cathodic reaction.

(ii) Calculate

- (a) Electric charge passed during electrolysis.
(b) Mass of copper deposited at the cathode.

[Given, 1 F = 96500 C mol^{-1}]

All India 2011C

13. Calculate the strength of the current required to deposit 1.2 g of magnesium from molten MgCl_2 in 1 h.

[1 F = 96500 C mol^{-1} , atomic mass of Mg = 24.0]

Delhi 2009C

14. Predict the products of electrolysis in each of the following:

- (i) An aqueous solution of AgNO_3 with silver electrodes.
(ii) A dilute solution of H_2SO_4 with platinum electrodes.

Gujarat Board-2021

15. (a) State and explain Faraday's laws of electrolysis.
(b) When a current of 0.5 ampere is passed through CuSO_4 solution for 30 minutes, 0.2964g, of copper is deposited. Calculate the atomic mass of copper.

Odisha Board-2023

16. In the extraction of Aluminium by electrolysis.
 i) Give the composition of electrolyte used.
 ii) Overall cell reaction.
 iii) Role of cryolite
- Karnataka Board-2016
17. Draw labelled diagram of Hall-Heroult Electrolytic cell for the extraction of aluminium. Write anode and cathode reactions.
- Karnataka Board-2014
18. Explain Electrophoresis.
- J&K Board-2019
19. Draw a neat labeled diagram of electrolytic cell used in the extraction of Aluminum by hall-heroult process.
 Write the reaction takes place at cathode and anode.
- Karnataka Board-2018
20. (i) Name the law or principle to which the following observations conform:
 (1) When water is added to a 1.0 M aqueous solution of acetic acid, the number of hydrogen ion (H^+) increases.
 (2) When 9650 coulombs of electricity is passed through a solution of copper sulphate 3.175 g of copper is deposited on the cathode (at. wt. of Cu = 63.5).
 (3) When ammonium chloride is added to a solution of ammonium hydroxide, the concentration of hydroxyl ions decreases.
- ISC Board-2017
21. 1M HNO_3 does not dissolved gold metal to form a 1M Au^{3+} solution. Explain this using the following to half reactions :
 (i) $NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O, E^\circ = 0.96\text{ V}$
 (ii) $Au^{3+} + 3e^- \rightarrow Au, E^\circ = 1.5\text{ V}$
- Manipur Board-2022
22. A solution of copper sulphate electrolysed for 20 minute with a current of 1.5 ampere. Calculate the mass of copper deposited a the cathode. ($F = 96500\text{ C}$)
- Rajasthan Board-2018
23. Write Faraday's second law of electrolysis.
- Rajasthan Board-2015
24. Give the chemical equation of the reaction, occurring at cathode in electrolysis of molten salt. What will be the effect, when its aqueous solution is used in place of molten salt?
- Rajasthan Board-2010
25. (d) Calculate the pH of 0.02 M $Ba(OH)_2$ aqueous solution assuming $Ba(OH)_2$ as a strong electrolyte.
- Tamilnadu Board, Sep.-2016
26. What is the potential of a half cell consisting of zinc electrode in 0.01 M $ZnSO_4$ solution 25°C , $E^\circ=0.763\text{ V}$?
- Tamilnadu Board, Sep.-2016
27. Write Faraday's laws of electrolysis.
- Gujarat Board-2017
28. State Faraday's first law. How much charge in terms of Faraday is required for the reduction of 1 mole of Cu^{2+} to Cu?
- Assam Board-2019
29. Define conductivity of an electrolytic solution. How does it vary with decrease in concentration and why?
- Assam Board-2019
30. Three electrolytic cells A, B and C containing electrolytes $ZnSO_4$, $AgNO_3$ and $CuSO_4$ respectively were connected in series. A steady current of 1.5A was passed through them. 1.45g Ag were deposited at the cathode of cell B.
 (i) How long did the current flow?
 (ii) What mass of copper and zinc were deposited? (At. mass of Cu = 63.5u, Zn = 65.3u and Ag = 108u)
- Assam Board-2017
31. Draw the labelled diagram of electrolytic cell of alumina and write the chemical reactions taking place in it.
- MP Board-2014
32. State and explain Faraday's laws of electrolysis.
- J&K Board-2020

Section-E : Long Answer

1. (b) State Faraday's First Law of Electrolysis. A solution of $CuSO_4$ is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode?
- Telangana Board-2017
2. Chromium metal is electroplated using an acidic solution containing CrO_3 according to the following equation:
 $CrO_3(aq) + 6H^+ + 6e^- \rightarrow Cr(s) + 3H_2O$
 Calculate how many grams of chromium will be electroplated by 24,000 coulombs. How long will it take to electroplate 1.5 g chromium using 12.5 A current?
 [Atomic mass of Cr = 52 g mol^{-1} , 1 F = 96500 C mol^{-1}]
- CBSE-2019
3. The reduction potential of a metal X is -0.76 V while that of Y is -2.38 V . Which of the two metals is a stronger reducing agent ? Give a reason for your answer.
- ISC Board-2010
4. When zinc granule is dipped into copper sulphate solution, copper is precipitated because
 (a) Both, copper and zinc have a positive reduction potential
 (b) Reduction potential of copper is higher than that of zinc
 (c) Reduction potential of zinc is higher than that of copper
 (d) Both, zinc and copper have a negative reduction potential
- ISC Board-2011

5. (i) State Faraday's first law of electrolysis. how much charge in terms of Faraday['s is required for the reduction of 1 mole of Cu^{2+} to Cu.
(ii) calculate emf of the following cell at 298 K.
 $\text{Mg(s)} \mid \text{Mg}^{2+} (0.1 \text{ M}) \parallel \text{Cu}^{2+} (0.01) \mid \text{Cu(s)}$
Given, $E^\circ_{\text{cell}} = + 2.71 \text{ V}$, $F = 96500 \text{ C mol}^{-1}$
- All India 2014
6. Three electrolytic cells A, B and C containing solutions of zinc sulphate, silver nitrate and copper sulphate respectively, are connected in series. A steady current of 1.5 A was passed through them until 1.45 g of silver were deposited at the cathode of cell B. How long did the current flow? What mass of copper and what mass of zinc were deposited in the concerned cells?
(Atomic mass of Ag = 108, Zn = 65.4, Cu = 63.5).
- HOTS; Delhi 2009; All India 2008
7. (i) Predict the products of electrolysis in each of the following:
(a) An aqueous solution of AgNO_3 with platinum electrodes.
(b) An aqueous solution of H_2SO_4 with platinum electrodes.
(ii) Estimate the minimum potential difference needed to reduce Al_2O_3 at 500°C . The Gibbs energy change for the decomposition reaction

$$\frac{2}{3}\text{Al}_2\text{O}_3 \longrightarrow \frac{4}{3}\text{Al} + \text{O}_2 \text{ is } 960 \text{ KJ.}$$

 $(F = 96500 \text{ C mol}^{-1})$
- Delhi 2014C
8. State Faraday's First Law of Electrolysis. Calculate the standard Gibb's free energy of an electrochemical cell in which the following reaction occurs at 25°C :
 $2\text{Al(s)} + 3\text{Fe}^{2+}(\text{aq}) \rightarrow 2\text{Al}^{3+}(\text{aq}) + 3\text{Fe(s)}$
Given:
 $E^\circ_{\text{Al}^{3+}/\text{Al}} = -1.66 \text{ V}$
 $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$
 $F = 96500 \text{ C}$
- Goa Board-2023
9. Write notes on:
(a) Faraday's second law of electrolysis
(b) Nuclear fission
- Odisha Board-2017
10. What type of process-spontaneous or non-spontaneous occurs in the following cells?
(i) electrolytic cell
(ii) galvanic cell
(b) Write the cell reaction and calculate emf of the following cell at 25°C :
 $\text{Zn(s)}|\text{Zn}^{2+} (0.001\text{M}) \parallel \text{H}^+ (0.01\text{M}) \mid \text{H}_2(\text{g})$
 $(1\text{bar}) \mid \text{Pt(s)}$
 $(E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}, E^\circ_{\text{H}^+/\text{H}_2} = 0.00 \text{ V})$
- NIOS Board-2023
11. a) A steady current of 2 amperes was passed through two electrolytic cells 'A' and 'B' connected in series containing electrolytes FeSO_4 and ZnSO_4 until 2.8g of Fe deposited at the cathode of cell 'A'. Find out the time of flow of current in the cell. Also calculate the mass of Zn deposited at the cathode of cell 'B' in the same time:
[Molar mass: Fe = 56.0g mol^{-1} , Zn = 65.3g mol^{-1} , $F = 96500 \text{ C mol}^{-1}$]
b) Predict the products of electrolysis of aqueous CuSO_4 solution using Pt-electrodes. Justify your answer.
- NIOS Board-2021
12. a) Draw labelled diagram of Standard Hydrogen Electrode (SHE). Write its half cell reaction and E° value. $3 + 2$
b) Calculate ΔG° for the following reaction:
 $\text{Fe}^{+2}(\text{aq}) + \text{Ag}_{(\text{aq})} \longrightarrow \text{Fe}_{(\text{aq})}^{+3} + \text{Ag}_{(\text{s})}$
(Give : $E^\circ_{\text{cell}} = +0.03 \text{ V}$, $F = 96500 \text{ C}$).
- Karnataka Board-2014
13. If 50 milliampere of current is passed through copper coulometer for 60 minutes calculate the amount of copper deposited.
- Tamil Nadu Board-2016
14. Give the different types of Batteries and explain the construction and working of each type of battery.
- Andhra Pradesh Board-2019
15. (a) Electrode potential of metals A, B, C and E are given below.
 $A^{+}/A = -2.93 \text{ V}$, $\frac{B^{+}}{B} = +0.80 \text{ V}$
 $C^{+}/C = 0.79 \text{ V}$, $D^{+}/D = -2.37 \text{ V}$ and
 $E^{+}/E = -0.74 \text{ V}$.
Arrange the metals in increasing order of reducing power. Give reason of your answer.
(b) What are amphiprotic species ? Name the amphiprotic species in the given reactions.
 $\text{HCO}_3^-(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{CO}_3^{2-}(\text{aq}) + \text{H}_2\text{O(l)}$
 $\text{H}_2\text{CO}_3(\text{aq}) + \text{CN}^-(\text{aq}) \rightleftharpoons \text{HCO}_3^-(\text{aq}) + \text{HCN}(\text{aq})$
- NIOS Board-2022
16. a) Draw the neat labeled diagram of Standard Hydrogen Electrode (SHE) and write its symbolic representation,
b) Calculate the emf of the cell in which the following reaction take place
 $\text{Ni}_{(\text{s})} + 2\text{Ag}_{(0.002\text{M})} \rightarrow \text{Ni}_{(0.160\text{M})} + 2\text{Ag}_{(\text{s})}$
[Given $E_{\text{cell}} = 1.05 \text{ V}$] $(2+3)$
- Karnataka Board-2015
17. Define the following terms :
(a) Isotonic solution
(b) Hypertonic solution
(c) Hypotonic solution
- Maharashtra board-2019

18. (a) What is the Faraday's first law of electrolysis ?
 (b) Predict the products of electrolysis in each of the following :
 (i) An aqueous solution of AgNO_3 with silver electrodes
 (ii) A dilute solution of H_2SO_4 with platinum electrodes
- Chhattisgarh Board-2022
19. (a) What are primary batteries?
 (b) The cell potential of a mercury cell is 1.35 V. and remain constant during its life Give reason.
 (c) Write the equations of the reactions involved at each electrode in a $\text{H}_2 - \text{O}_2$ fuel cell.
- Kerala Board-2018
20. What is electrolysis ? Discuss electrolysis of molten NaCl .
- Haryana Board -2016
21. Discuss Second Law of Faraday Law of electrolysis
- Haryana Board-2018
22. Draw the labelled diagram of electrolytic cell in the extraction of aluminium metal from pure and anhydrous alumina. What will be the two effects, when cryolite and fluorspar are not mixed in it?
- Rajasthan Board-2010
23. (b) derive Nernst equation of a reversible cell reaction.
- Tamilnadu Board, Sep.-2016
24. How many spoons can be electroplated by silver when 7 ampere current is passed through electrolyte cell of AgNO_3 for 1.93 hours? 0.01 gm Ag layer is deposited on each spoon. ($\text{Ag} = 108 \text{ g.mol}^{-1}$)
- Gujarat Board-2018
25. How many grams of Cu and what volume of O_2 gas will be obtained at 300K temperature and 1 bar pressure by passing 20 ampere current for 96.5 minutes from an aqueous solution of CuSO_4 ? The efficiency of the electrolytic cell is 90%. ($\text{Cu} = 63.5$).
- Gujarat Board-2017
26. For how much time 4.8 ampere current should be passed through 100 ml 0.025 M agNO_3 solution during the electrolysis so that Ag is completely deposited?
- Gujarat Board-2018
27. Calculate the value of cell potential of the following cell at 298 K.
 $\ominus\text{Pt}|\text{H}_2(1\text{bar})|\text{KOH}(0.002\text{m})||\text{HCl}(0.005\text{m})|\text{H}_2(1\text{bar})\text{PT}^{\oplus}$ (AT 298 K temperature ionic product of water is 1.0×10^{-14}).
- Gujarat Board-2019
28. A solution of CuSO_4 is electrolysed for 8 minutes 45 seconds with a current of 5 amperes. What is the mass of copper deposited at the cathode?
- Gujarat Board-2020
29. (a) A current of 1.50 A was passed through an electrolytic cell containing AgNO_3 solution with inert electrodes. The mass of silver deposited in cathode was 1.50 g. How long did the current flow?
 (Atomic mass of Ag = 108 u, 1F = 96500 C).
30. Given the standard electrode potential value of some metals
 $\text{K}^+ / \text{K} = -2.93\text{V}$, $\text{Ag}^+ / \text{Ag} = 0.80\text{V}$,
 $\text{Hg}^{2+} / \text{Hg} = 0.79\text{V}$, $\text{Mg}^{2+} / \text{Mg} = -2.37\text{V}$,
 $\text{O}^{3+} / \text{Cr} = -0.74\text{V}$
 Arrange these metals in their increasing order of reducing power.
- Assam Board-2012
31. Three electrolytic cells A, B and C containing electrolytes ZnSO_4 , AgNO_3 and CaSO_4 respectively were connected in series. A steady current of 1.5A was passed through them and 1.45g Ag was deposited at the cathode of cell B.
 (i) How long did the current flow?
 (ii) What mass of copper and zinc were deposited?
 Given atomic mass of Cu = 63.5u , Zn = 65.3u , and Ag = 108u
- Assam Board-2023

F. Batteries

Section-A : Multiple Choice Questions

1. In a lead storage battery
 (a) PbO_2 is reduced to PbSO_4 at the cathode
 (b) Pb is oxidised to PbSO_4 at the anode.
 (c) Both electrodes are immersed in the same aqueous solution of H_2SO_4 .
 (d) All the above are true

CBSE-2020

Ans. (c)

2. Which of the followings is correct while charging the lead storage battery?
 (a) PbSO_4 cathode is reduced to Pb.
 (b) PbSO_4 cathode is oxidized to Pb
 (c) PbSO_4 anode is oxidized to PbO_2
 (d) PbSO_4 anode is reduced to Pb.

Manipur Board-2018

Ans. (d)

3. Which mixture acts as cathode in mercury cell?
 (a) $\text{KOH} + \text{ZnO}$ (b) $\text{MnO}_2 + \text{C}$
 (c) $\text{HgO} + \text{C}$ (d) $\text{Zn} - \text{Hg/CdO}$

Gujarat Board-2018

Ans. (c)

Section-B : Very Short Answer

1. Why is the blue colour of copper sulphate solution slowly discharged when a rod of zinc is dipped in it ? **CBSE-2020**

2. What type of battery is lead storage battery? Write the anode and cathode reactions, and the overall cell reaction occurring in the operation of a lead storage battery. **Delhi 2012, 2011, 2009; foreign 2012; All India 2009**

3. What type of a battery is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it. **Delhi 2012, 2011, 2009; All India 2012, 2009, Foreign 2012**

4. While giving labelled diagram of dry cell write reactions taking place at cathode and anode. **Haryana Board-2019**

5. What is a secondary cell ? Write the equation for the cathode reaction of lead storage battery. **Karnataka Board-2016**

6. Write the name of a cell used in small watches. **Rajasthan Board-2011**

Section-C : Short Answer

1. Write chemical equations for charging and discharging of Lead storage cell.
MP Board 2020

2. Explain dry cell and lead storage cell.
Gujarat Board-2016

(iii) Draw a neat and labelled diagram of lead storage battery.
Maharashtra board-2018

3. (i) The electrolyte used in Lead-storage battery—
(ii) Give one example for a primary cell.
Kerala Board-2021

4. Write the anode and cathode reactions occur in the operation of a lead storage battery. Mention the electrolyte used in the battery.
Kerala Board-2018

5. (a) State Kohlrausch law of independent migration of ions.
(b) What is a primary battery? Give one example.
(c) Three electrolytic cells A, B and C containing electrolytes ZnSO_4 , AgNO_3 and CuSO_4 respectively were connected in series. A steady current of 1.5 A was passed through them. 1.45 g Ag were deposited at the cathode of cell B.
(i) How long did the current flow?
(ii) What mass of copper and zinc were deposited? (Atomic mass of Cu = 63.5 u, Zn = 65.3 u, Ag = 108 u)
Assam Board 2013

Section-E : Long Answer

- Calculate electromotive force (e.m.f.) for the following cell reaction
 $Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$
 Where the values of $E_{Zn^{2+}/Zn}^o$ and $E_{Ag^+/Ag}^o$ are respectively -0.76 V and $+ 0.80$ V.
Chhattisgarh Board-2023
 - When iron rod is dipped in $CuSO_4$ solution, copper is displaced but when copper rod is dipped in $FeSO_4$ solution, iron does not get displaced. Explain why.
Chhattisgarh Board-2023
 - When zinc rod is dipped in blue $CuSO_4$ solution it decolourises. Why?
 (i) If the concentration of copper sulphate solution is 0.01 M and that of zinc sulphate solution is 0.1 M, then calculate the E.M.F. of Daniell cell at 298 K. ($E_{cell}^o = 1.1V$)
Chhattisgarh Board-2023
 - What is electrochemical series? Write Kohlrausch law with its two applications.
Chhattisgarh Board-2022
 - How many spoons can be electroplated by silver when 5 ampere current is passed through electrolytic cell of $AgNO_3$ for 2.5 hours? Efficiency of the cell is 80% and 0.01 gram Ag layer is deposited on each spoon. ($Ag=108$ gm/mole).
Gujarat Board-2019
 - What is the standard electrode potential of the half cell corresponding to the reaction?
 $Cu^{2+}(aq, 1M) + 2e^- \rightarrow Cu(s)$
 $Pt(s)|H_2(g, 1bar)|H^+(aq, 1M)||Cu^{2+}(aq, 1M)|Cu(s)$
Assam Board-2018
 - What is standard hydrogen electrode? How it is made?

G. Fuel Cells

Section-A : Multiple Choice Questions

9. From the given cells:
Lead storage cell, Mercury cell, Fuel cell and Dry cell
Answer the following:
 (i) Which cell is used in hearing aids?
 (ii) Which cell was used in Apollo Space Programme?
 (iii) Which cell is used in automobiles and inverters?
 (iv) Which cell does not have long life?
- Delhi 2016
10. Draw a neat labelled diagram of the Hydrogen-Oxygen fuel cell.
- Goa Board-2023
11. Write the reactions occurring in hydrogen fuel cell.
- Gujarat Board-2016
12. Draw a neat labeled diagram of $H_2 - O_2$ fuel cell. Write the reaction occurs at cathode of the cell.
(elec. Chemis)
- Karnataka Board-2018
13. Write the cathodic and anodic cell reactions of Hydrogen-Oxygen fuel cell.
- Karnataka Board-2017
14. What is a fuel cell? Write the equation which occurs at the electrode in a fuel cell that uses H_2 and O_2 to produce electricity.
- J&K Board-2019
15. Write the anodic reaction taking place at $H_2 - O_2$ fuel cell.
- Karnataka Board-2017
16. Draw a neat labelled diagram of $H_2 - O_2$ fuel cell and write overall cell reaction.
- Karnataka Board-2018
17. When hydrogen gas is used as fuel the combustion reaction is represented as
 $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$. When $[O_2]$ is decreasing at $0.23\text{ mol L}^{-1}\text{ s}^{-1}$, at what rate is $[H_2O]$ increasing ?
- Manipur Board-2022
18. Draw a neat labelled diagram of the Hydrogen-Oxygen fuel cell.
- Goa Board-2019
19. One of the fuel cells uses the reaction of hydrogen and oxygen to form water. Write down the cell reaction taking place in the anode and cathode of that fuel cell.
- Kerala Board-2016
20. Name one substance other than hydrogen that can be used for construct fuel cells.
- Assam Board-2016
- (b) Predict the products of electrolysis of electrolysis of dilute sulphuric acid at the respective electrodes.
- Goa Board-2018
4. Draw labelled diagram of $H_2 - O_2$ fuel cell. Write two applications of fuel cell.
- Maharashtra board-2023
5. Diagrammatically represent $H_2 - O_2$ fuel cell and write the half cell reactions taking place in this cell.
- Kerala Board-2019
6. Galvanic cells are classified into primary and secondary cells.
 (a) Write any two differences between primary cell and secondary cell.
 (b) (i) What is a fuel cell?
 (ii) Write the overall cell reaction in $H_2 - O_2$ fuel cell.
- Kerala Board-2016
7. Define fuel cell? Give one use.
- Haryana Board-2018
8. Fuel Cells are better than other cells. Give any two reasons.
- Rajasthan Board-2018
9. Draw the labelled diagram of Daniell cell.
- Rajasthan Board-2013
10. Write an example of a fuel cell. Write its two characteristics.
- Rajasthan Board-2011
11. Draw a labeled diagram of fuel cell.
- Rajasthan Board-2011
12. Calculate the equilibrium constant of the following reaction at 298 K.
 $Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$
 Given, $E_{cell}^\ominus = 0.46V$
- Assam Board-2012
13. Explain the dry cell with diagram.
- MP Board-2013
- Section-E : Long Answer**
1. In the electrochemical cell;
 $Zn/ZnSO_4 (0.1\text{ M})//CuSO_4 (0.1\text{ M})/Cu$, the e.m.f. of the Deniel cell is E_1 . When the concentration of $ZnSO_4$ changed to 1.0 M and $CuSO_4$ changed to 0.01M, the e.m.f. of the cell changes to E_2 . Establish the relation between E_1 and E_2 .
- Assam Board-2022
2. How many grams of Cu and what volume of O_2 gas will be obtained if 18.4 ampere electric current is passed through the electrolytic cell of $CuSO_4$ for 1 hour and 42 minutes between graphite electrodes at 298K temperature and 1 bar pressure? Efficiency of cell is 75%. ($Cu = 63.5\text{ u}$, $O = 16\text{ u}$).
- Gujarat Board-2019
3. (i) Explain the construction and working of $H_2 - O_2$ fuel cell.
 (ii) Write two methods to prevent corrosion of metals.
- Kerala Board-2021

Section-C : Short Answer

1. Describe structure of fuel cell.
 Rajasthan Board 2023
2. Draw labeled diagram of fuel cell.
 Rajasthan Board 2023
3. (a) Draw a neat labelled diagram of hydrogen – oxygen fuel cell.

4. Draw a neat labelled diagram of a Dry cell write the cell and write the cell reactions taking place at both the electrodes.
Write any two advantages of fuel cells.
Draw a neat labelled diagram of lead storage cell and write the reactions taking place at both the electrodes during discharging of the cell.
- Goa Board-2019
5. (a) Depict the galvanic cell in which the following reaction takes place:
 $Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$
- (b) Write the Nernst equation of the following cell:
 $Mg(s) | Mg^{2+}(0.001M) || Cu^{2+}(0.0001M) | Cu(s)$
- Assam Board-2014
6. Write Anodic and Cathodic reaction for Dry cell and Lead storage cell (discharging).
- Gujarat Board-2020

H. Corrosion

Section-A : Multiple Choice Questions

1. Corrosion of iron is"
 (a) a decomposition process
 (b) a photochemical process
 (c) an electrochemical process
 (d) a reduction process
- Gujarat Board 2023 (July)

Ans. (c)

2. Zinc is coated over iron to prevent rusting of iron because
 (a) $E_{Zn^{2+}/Zn}^o = E_{Fe^{2+}/Fe}^o$ (b) $E_{Zn^{2+}/Zn}^o < E_{Fe^{2+}/Fe}^o$
 (c) $E_{Zn^{2+}/Zn}^o > E_{Fe^{2+}/Fe}^o$ (d) None of these
- CBSE-2020

Ans. (c)

3. Rust is a mixture of:
 (a) Fe_2O_3 (b) $Fe_2O_3 \& Fe(OH)_3$
 (c) $FeO \& Fe(OH)_3$ (d) $Fe_3O_4 \& Fe(OH)_3$
- Haryana Board-2017

Ans. (c)

Section-B : Very Short Answer

1. Suggest any two methods to prevent corrosion of metal.
 Karnataka board 2023
2. The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.
 Delhi 2011, 2009; Foreign 2011, 2009
3. Zinc protects iron from corrosion better than tin. Given reason.
 Manipur Board-2017
4. What is Corrosion? Name one method to prevent it.
 Karnataka Board-2014
5. Fill the blanks:
 (c) Chemical formula of corrosive sublimate is _____
- MP Board-2017

Section-C : Short Answer

1. The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.
- Assam Board-2022
2. Define corrosion. Write two preventions from corrosion.
- MP Board 2020
3. Corrosion is an electrochemical phenomenon. Explain.
- Rajasthan Board-2019
4. Write the name of metal used in sacrificial electrode for the prevention of corrosion of iron metal how its prevent the corrosion.
- Rajasthan Board-2017
5. Write the complete chemical reaction of rusting of iron.
- Rajasthan Board-2014
6. Write the names of two techniques used for preventing corrosion.
- Rajasthan Board-2011
7. Explain corrosion of iron in atmosphere with reactions. (Figure is not necessary).
- Gujarat Board-2020
8. What is corrosion? Give two measures for the prevention of corosions of metals.
- Assam Board-2015
9. 10.07 gram Silver obtained during the circulations of electric of 5 ampere upto 30 minutes in silver nitrate Pot (cell). Find out electrochemical equivalent of silver. If chemical equivalent of hydrogen is 0.00001036 then what will be equivalent we weight of silver.
- MP Board-2016
10. (i) What do you understand by corrosion.
 (ii) Write electro-chemical theory of corrosion (Rust).
 (iii) Write prevention (two) of corrosion.
- MP Board-2016
11. Define corrosion. What is the chemical formula of rust ?
- J&K Board-2020

Section-D : Case Based Study

1. Explain chemistry of corrosion and state two methods to stop corrosion.
- Gujarat Borad-2022 (July)
2. Define Corrosion. What is the chemical formula of rust?
- Haryana Board-2018
3. Explain corrosion on the basis of following points—
 (i) Definition
 (ii) Factors affecting any two
 (iii) Prevention of corrosion any two
- Haryana Board-2016
- MP Board-2015

Chemical Kinetics

A. Rate of Chemical Reaction
Section-B : Very Short Answer

1. Explain the effect of temperature and catalyst on the rate of chemical reaction.
Kerala Board 2023
2. Mention any two factors that affect the rate of a chemical reaction.
Karnataka board 2023
3. Give reason:
 - (a) The rate of a reaction does not remain constant throughout the course of reaction.
 - (b) Powdered sugar dissolves in water faster than crystalline sugar.**CBSE-2020**
4. Define rate of reaction. Write two factors that affect the rate of reaction.
CBSE-2022
5. Unit of rate of reaction is.....
ISC Board-2014
6. List the factors on which the rate of a chemical reaction depends.
Delhi 2008; all India 2008; Foreign 2008
7. Explain the difference between the average rate and instantaneous rate of a chemical reaction.
All India 2010C
8. Define the following.
 - (i) Elementary step in a reaction
 - (ii) Rate of a reaction**All India 2009
foreign 2009**
9. Define rate of reaction. Write two factors that affect the rate of reaction.
All India 2015
10. Why does the rate of a reaction not remain constant throughout the reaction process?
Delhi 2011
11. Define rate of a reaction.
Delhi 2010; All India 2010
12. Express the rate of the following in terms of ammonia.
 $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
Delhi 2013C
13. For the reaction
 $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$
The rate of formation of $NO_2(g)$ is $2.8 \times 10^{-3} \text{ Ms}^{-1}$. Calculate the rate of disappearance of $N_2O_5(g)$.
UP Board-2018
14. Explain the factors affecting rate of a reaction.
Punjab Board-2021

15. What is effect of temperature on rate of a reaction?
Haryana Board-2022
16. The sum of the powers of the concentration of the reactants in rate law called.....
Haryana Board-2021
17. The conversion of molecules X to Y follows second order kinetics. If the concentration of X is increased to three times, how will it affect the rate of formation of Y?
Karnataka Board-2020
18. Describe the factors affecting rate of chemical reaction (any three).
Chhattisgarh Board-2021
19. The rate of decomposition of N_2O_5 to NO_2 and O_2 is expressed as

$$k = \frac{2.303}{t} \log \frac{x_0}{x_t},$$

Where x_0 and x_t are the initial concentration and concentration at time t of N_2O_5 . Show that the half-life period of the reaction is independent of x_0 .
Manipur Board-2022
20. Write differential rate equation for the reaction, $2A + B \rightarrow \text{product}$.
Rajasthan Board-2015
21. State the rate law for chemical reaction.
Nagaland Board-2020

Section-C : Short Answer

1. Account for the following :
 - (a) The rate of a reaction does not remain constant throughout the course of reaction.
 - (b) The boiling of an egg or cooking rice in an open vessel takes more time in hilly areas.
 - (c) In some cases it is found that a large number of colliding molecules have energy more than the threshold value, yet the reaction is slow.**CBSE-2019**
2. In a pseudo first order hydrolysis of ester in water, the following results are obtained.

t(in s)	0	30	60	90
[Ester]M	0.55	0.31	0.17	0.085

 - (i) Calculate the average rate of reaction between the time interval 30 to 60 s.
 - (ii) Calculate the pseudo first order rate constant for the hydrolysis of ester.
All India 2010C
3. Explain rate of chemical reaction.
Jharkhand Board-2019
4. Explain the dependence of rate of reaction on temperature.
Chhattisgarh Board-2020
5. Write four differences between rate of reaction and rate constant.
MP Board-2018

Section-E : Long Answer

1. When water is added to compound 'A' of calcium, solution of compound 'B' is formed. When CO_2 is passed into this solution, it turns milky due to the formation of compound 'C'. Identify the compounds 'A', 'B' and 'C'. Write the chemical reactions involved. Give biological role of Ca^{2+} .

NIOS Board-2021

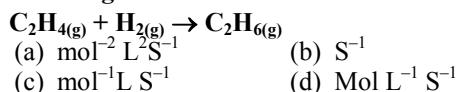
2. Discuss the effect of temperature on the rate of reaction.

J & K Board-2021

B. Rate Law and Rate Constant

Section-A : Multiple Choice Questions

1. What will be the unit of rate constant for following reaction?



Gujarat Board 2023 (March)

Ans. (c)

2. Identify the reaction order for which rate constant $K = 2.3 \times 10^{-5} \text{ L mol}^{-1} \text{s}^{-1}$.

- (a) Zero (b) First
 (c) Second (d) Third

Gujarat Board 2022 (July)

Ans. (c)

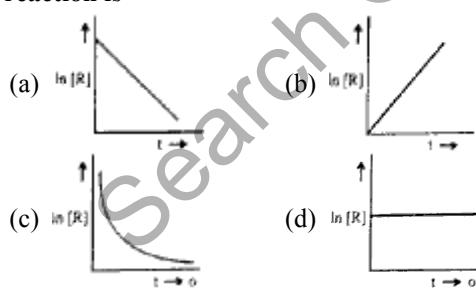
3. Identify the order of reaction from the given rate constant $K = 1.6 \times 10^{-6} \text{ L Mol}^{-1} \text{ Sec}^{-1}$:

- (a) Zero (b) First
 (c) Second (d) None of these

Haryana Board 2023

Ans. (a)

4. The plot between $\ln[R]$ and t for first order reaction is—



Rajasthan Board 2022

Ans. (a)

5. The unit of velocity constant for first order reactions is—

- (a) $\text{mol}^{-1} \text{L s}^{-1}$
 (b) $\text{mol L}^{-2} \text{s}^{-1}$
 (c) s^{-1}
 (d) $\text{mol L}^{-1} \text{s}^{-1}$

UP Board 2023

Ans. (c)

6. The unit of rate constant depends upon the

- (a) molecularity of the reaction.
 (b) activation energy of the reaction.
 (c) order of the reaction
 (d) temperature of the reaction.

CBSE-2020

Ans. (c)

7. The rate constant for a first order reaction is equal to the initial rate of reaction when the initial concentration of the reactant is

- (a) $1 \times 10^{-2} \text{ M}$ (b) 1 M
 (c) 10 M (d) 0.1 M

CBSE-2020

Ans. (b)

8. The rate constants of the forward reaction and reverse reaction are 0.05 sec^{-1} and 2 sec^{-1} respectively, then K_c is;

- (a) 0.035 (b) 0.025
 (c) 0.045 (d) 0.02

Tamil Nadu Board-2018

Ans. (b)

9. The sum of the powers of the concentration terms that occur in the rate equation is called:

- (a) Rate (b) Molecularity
 (c) Rate constant (d) Order

Tamil Nadu Board-2018

Ans. (d)

10. Rate constant for a reaction is Rate = $k [A]^x [B]^{y-3/2}$ the order of reaction is:

- (a) 3.0 (b) 0.5
 (c) 1 (d) -0.5

Haryana Board-2022

Ans. (b)

11. Unit of rate constant of third order reaction, k is

- (a) s^{-1} (b) $\text{mol}^{-1} \text{L s}^{-1}$
 (c) $\text{mol}^{-2} \text{L}^2 \text{s}^{-1}$ (d) $\text{mol L}^{-1} \text{s}^{-1}$

Jharkhand Board-2018

Ans. (c)

12. The unit of rate constant of a first order chemical reaction is

- (a) $\text{mol}^{-1} \text{L s}^{-1}$ (b) s^{-1}
 (c) $\text{mol L}^{-1} \text{s}^{-1}$ (d) $\text{mol}^{-2} \text{L}^2 \text{s}^{-1}$

Kerala Board-2022

Ans. (b)

13. Unit of rate constant for a Zero order reaction is:

- (a) $\text{mol L}^{-1} \text{s}^{-1}$ (b) $\text{L mol}^{-1} \text{s}^{-1}$
 (c) $\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$ (d) s^{-1}

Haryana Board-2017

Ans. (a)

14. The units of rate constant for first order reaction is:

- (a) Time $^{-1}$
 (b) Concentration $^{-1}$ Time $^{-1}$
 (c) Concentration 2 Time $^{-2}$
 (d) None of these

Haryana Board-2018

Ans. (a)

Section-B : Very Short Answer

1. How catalyst increases the rate of reaction? Explain it by graph.
 Gujarat Board 2023 (March)
2. Derive equation of rate constant for first order reaction.
 Gujarat Board 2022 (July)
3. Derive expression for rate constant of First order reaction.
 MP Board 2020
4. In a first order reaction the concentration of a substance gets dissociated by 99% of the initial concentration in 100 minutes. Calculate the velocity constant of the reaction.
 UP Board 2023
5. What is the relation between rate constant and activation energy of a reaction? Illustrate the effect of a negative catalyst on activation energy by plotting a curve between the reaction co-ordinate and energy.
 Manipur Board 2020
6. Write the unit of rate constant for zero order reaction.
 Rajasthan Board 2022
7. What is the order of reaction which has rate expression Rate = $K[A]^{-1} \cdot [B]^{5/3}$?
 Karnataka board 2023
8. Mention a factor
 (i) Which affects the rate of reaction as well as magnitude of the rate constant.
 (ii) Which affects the rate of reaction but not the magnitude of the rate constant.
 Manipur Board 2023
9. Ozone in the stratosphere is decomposed by nitrogen monoxide in reaction give as-
 $O_3 + NO \rightarrow O_2 + NO_2$
 Write the rate law and predict its overall order.
 Manipur Board 2023
10. When the added substance reduces the rate of reaction, then it called _____ in place of catalyst.
 Rajasthan Board 2023
11. Will the rate constant of the reaction depend upon T if the E_{act} (activation energy) of the reaction is zero ?
 CBSE-2020
12. The rate constant for a first order reaction is 40 S^{-1} . How much time will it take to reduce the initial concentration of the reactant to its $\frac{1}{10}$ th value ? [$\log 10 = 1$]
 CBSE-2022
13. A first order reaction is 50% complete in 40 minutes. Calculate the time required for the completion of 90% of reaction.
 [Given : $\log 2 = 0.3010$, $\log 10 = 1$]
 CBSE-2022
14. Identify the order of reaction from each of the following units of rate constant (k) :
 (a) $\text{mol L}^{-1} \text{ sec}^{-1}$ (b) $\text{mol}^{-1} \text{ sec}^{-1}$
 ISC Board-2017
15. For the first order thermal decomposition reaction, the following data obtained:
 $C_2H_5Cl(g) \longrightarrow C_2H_4(g) + HCl(g)$
- | Time/s | Total pressure/atm |
|--------|--------------------|
| 0 | 0.30 |
| 300 | 0.50 |
- Calculate the rate constant.
 (Given: $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$)
 All India 2016
16. The rate constant for a first order reaction is 60 s^{-1} . How much time will it take to reduce the initial concentration of the reactant to its $1/10^{\text{th}}$ value?
 All India 2015C
17. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume:
 $SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$
- | Experiment | Time | Total pressure/atm |
|------------|------|--------------------|
| 1 | 0 | 0.4 |
| 2 | 100 | 0.7 |
- Calculate the rate constant.
 (Given, $\log 4 = 0.6021$, $\log 2 = 0.3010$)
 Delhi 2014
 All India 2014
 Foreign 2014
18. In a first order reaction, the concentration of the reactant is reduced from 0.6 mol L^{-1} to 0.2 mol L^{-1} in 5 min. calculate the rate constant of the reaction.
 All India 2011C
19. The rate constant for a zero order reaction in A is $0.0030\text{ mol L}^{-1} \text{ s}^{-1}$. How long will it take for the initial concentration of A to fall from 0.10 M to 0.075 M ?
 Delhi 2010
 Foreign 2010
20. Discuss any four factors which affect the rate of a chemical reaction.
 Delhi 2010C
 All India 2008
21. Distinguish between rate expression and rate constant of a reaction.
 Delhi 2011
22. Express clearly, what do you understand by rate expression and rate constant of a reaction?
 Foreign 2011
23. A reaction is of second order with respect to a reactant. How is the rate of reaction affected, if the concentration of the reactant is reduced to half? What is the unit of rate constant for such a reaction?
 Delhi 2014
 All India 2011

24. What is the equilibrium constant expression for the reaction?
 $P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s)$
Odisha Board-2017
25. The rate law for the reaction $2X + Y_2 \rightarrow 2Z$ is
Rate = $k [X][Y_2]^2$
What are the units of the rate constant, k?
 $2X + Y_2 \rightarrow 2Z$
NIOS Board-2015
26. Unit of rate constant of a reaction is same as that of its rate, what is the order of the reaction?
Karnataka Board-2019
27. The rate constant for a first order reaction is 90 s^{-1} . How much time will it take to reduce the concentration of the reactant to $\frac{1}{20}$ th of its initial value ?
Punjab Board-2019
28. For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.
Punjab Board-2021
29. A first order reaction takes 40 min for 30% decomposition Calculate half life period.
Punjab Board-2021
30. Calculate the half life of a first order reaction from rate constant 500 sec^{-1} .
Haryana Board-2021
31. 75% of the first order reaction is completed in 30 minutes. Calculate rate constant of the reaction.
Karnataka Board-2016
32. In a reaction $2A \rightarrow$ product, the concentration of A decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the rate during this interval.
Karnataka Board-2017
33. Calculate the overall order of a reaction which has the rate expression Rate = $K[A]^1[B]^1$
Jharkhand Board-2019
34. For the reaction, $2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$, the rate law is given as, Rate = $k[NO]^2[O_2]$. The order of the reaction with respect to O_2 is _____.
Kerala Board-2019
35. Identify the order of reaction if the unit of rate constant in $\text{mol L}^{-1}\text{s}^{-1}$.
Kerala Board-2018
36. Why does the rate decomposition of N_2O_5 increase when the temperature changes from 0°C to 50°C ?
Goa Board-2019
37. (a) What do you mean by rate of a reaction?
(b) What will be the effect of temperature on rate of a reaction ?
Kerala Board-2016
38. Write the unit of rate constant for the reaction $A + 3B \rightleftharpoons 2C$.
Rajasthan Board-2010

Section-C : Short Answer

1. The following data were obtained during the first order thermal decomposition of $N_2O_5(g)$ at constant volume : $2N_2O_5(g) \rightarrow 2N_2O_4(g) + O_2(g)$
- | S. No. | Time(s) | Total Pressure(atm) |
|--------|---------|---------------------|
| 1 | 0 | 0.5 |
| 2 | 100 | 0.512 |
- Calculate the rate constant
Gujarat Board 2023 (March)
2. (a) Rate constant for the first order reaction has been found to be $K = 2.54 \times 10^{-3}\text{ sec}^{-1}$. Calculate its three-fourth life. ($\log 2 = 0.301$)
UP Board 2019
3. The following data were obtained during the first order thermal decomposition of C_2H_5Cl at a constant volume:
 $C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g)$
- | Experiment | Time(s^{-1}) | Total pressure (atm) |
|------------|------------------|----------------------|
| 1 | 0 | 0.4 |
| 2 | 100 | 0.6 |
- Calculate the rate constant.
(Given : $\log 2 = 0.3010$, $\log 3 = 0.47771$, $\log 4 = 0.6021$)
Gujarat Board 2023 (July)
4. The rate constant for the first order decomposition of N_2O_5 is given by the following equation:

$$\log k = 23.6 - \frac{2 \times 10^4 K}{T}$$
- Calculate E_a for this reaction.
 $[R = 8.314\text{ K}^{-1}\text{ mol}^{-1}]$
Gujarat Board 2023 (July)
5. Cyclopropane undergoes isomerization at 1000°C to propylene following order kinetics with a rate constant 9.9s^{-1} . How long would it take for the concentration of cyclopropane to decrease to 50% of its initial value?
Manipur Board 2023
6. The rate constant for the first order decomposition of N_2O_5 is given by the following equation :
 $k = (2.5 \times 10^{14}\text{ s}^{-1}) e(-25000K)/T$
Calculate E_a for this reaction and rate constant if its half-life period be 300 minutes.
CBSE-2020
7. The following reaction was carried out in water:
 $Br_2 + 2I^- \longrightarrow 2Br^- + I_2$
The initial concentration of I^- was 0.30 M and the concentration after 10 minutes reduced to 0.28 M . Calculate the rate of disappearance of I^- and production of I_2 .
CBSE-2021

8. The decomposition of a compound is found to follow a first order rate law. If it takes 15 min for 20% of original material to react, calculate
 (i) the rate constant.
 (ii) the time at which 10% of the original material remains unreacted.
- Delhi 2010C
9. Nitrogen pentoxyde decomposes according to equation, $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$
 The first order reaction was allowed to proceed at 40°C and the data below were collected.
- | $[\text{N}_2\text{O}_5]$ M | Time (min) |
|----------------------------|------------|
| 0.400 | 0.00 |
| 0.289 | 20.0 |
| 0.209 | 40.0 |
| 0.151 | 60.0 |
| 0.19 | 80.0 |
- (i) Calculate the rate constant. Include units with your answer.
 (ii) Calculate the initial rate of reaction.
 (iii) After how many minutes will $[\text{N}_2\text{O}_5]$ be equal to 0.350 M?
- Foreign 2011
10. The reaction $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$ contributes to air pollution whenever a fuel is burnt in air at a high temperature. At 1500K, equilibrium constant K for it is 1.0×10^{-5} . Suppose in a case $[\text{N}_2] = 0.80 \text{ mol L}^{-1}$ and $[\text{O}_2] = 0.20 \text{ mol L}^{-1}$ before any reaction occurs. calculate the equilibrium concentrations of the reactants and the product after the mixture has been heated in 1500 K.
- All India 2012
11. For the reaction,
 $2\text{NO}(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NOCl}(\text{g})$
 The following data were collected. All the measurements were taken at 263 K.
- | Exp. No | Initial [No] (M) | Initial $[\text{Cl}_2]$ (M) | Initial rate of disappearance of Cl_2 (M/min) |
|---------|------------------|-----------------------------|--|
| 1. | 0.15 | 0.15 | 0.60 |
| 2. | 0.15 | 0.30 | 1.20 |
| 3. | 0.30 | 0.15 | 2.40 |
| 4. | 0.25 | 0.25 | ? |
- (i) Write the expression for rate law.
 (ii) Calculate the value of rate constant and specify its unit.
 (iii) What is the initial rate of disappearance of Cl_2 in experiment 4?
- Delhi 2012
12. Why does the rate decomposition of N_2O_5 increase when the temperature changes from 0°C to 50°C?
- Goa Board-2023
13. What are important characteristics of rate constant ?
- Haryana Board -2016
14. Derive the rate constant formula for zero order reaction?
- Rajasthan Board-2016
15. Write the units of rate constants for zero order and first order reactions.
- Rajasthan Board-2013
16. (a) A reaction is first order in A and second order in B.
 (i) Write the differential rate equation.
 (ii) How is the rate affected on increasing the concentration of B three times?
- Assam Board-2020
17. What will be the effect of temperature on rate constant?
- Assam Board-2019
18. (a) The rate constant of a reaction is $3 \times 10^2 \text{ min}^{-1}$. What is the order of the reactions?
 (b) The concentration of a solution having concentration 0.24 M is reduced to 0.12 M in 10 hours and 0.06 M in 20 hours. What is the rate constant of the reaction?
 (c) A reaction, $\text{SO}_2\text{Cl}_2 \rightarrow \text{SO}_2 + \text{Cl}_2$ is first order reaction with half life period $3.15 \times 10^4 \text{ s}$ at 320° C. What percentage of SO_2Cl_2 Would be decomposed on heating at 320°C for 90 minutes?
 $\text{SO}_2\text{Cl}_2 \rightarrow \text{SO}_2 + \text{Cl}_2$
- Assam Board-2012
19. Write four differences between rate or reaction and rate constant.
- MP Board-2014
20. The rate constant of a first order reaction becomes 5 times when the temperature is raised from 350K to 400K. Calculate the activation energy of the reaction. ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$, $\log 5 = 0.69897$).
- Nagaland Board-2018

Section-D : Case Based Study

1. The rate constant of a reaction at 500K and 700K are 0.02 s^{-1} and 0.07 s^{-1} respectively. Calculate the value of Ea and what will be the rate constant at 600 K temperature.

Gujrat Borad-2022 (July)

Section-E : Long Answer

1. (a) The rate constant for a first order reaction is 60 s^{-1} . How much time will it take to reduce the initial concentration of the reactant to its $\frac{1}{16}$ th value?
 (b) Write two factors that affect the rate of a chemical reaction.
 (c) Write two conditions for the collisions to be effective collisions.

CBSE-2020

2. Consider the reaction,
 $2A + B \rightarrow C + D$
 Following results were obtained from experiments designed to study the rate of reactions.
- | Exp. No. | [A] | Initial concentration (mol L ⁻¹) | Initial rate of formation [D] (M/min) |
|----------|------|--|---------------------------------------|
| | [B] | | |
| 1. | 0.10 | 0.10 | 1.5×10^{-3} |
| 2. | 0.20 | 0.20 | 3.0×10^{-3} |
| 3. | 0.20 | 0.40 | 6.0×10^{-3} |
- (i) Write the rate law for the reaction.
 (ii) Calculate the value of rate constant for the reaction.
 (iii) Which of the following possible reaction mechanisms is consistent with the rate law?
 I. $A + B \rightarrow C + E$ (slow)
 $A + E \rightarrow D$ (fast)
 II. $B \rightarrow C + E$ (slow)
 $A + E \rightarrow F$ (fast)
 $A + F \rightarrow D$ (fast)
- HOTS; Foreign 2012
3. The following results have been obtained during kinetic studies of the reaction:
 $2A + B \rightarrow C + D$
- | Exp. No. | [A] | [B] | Initial rate of formation of D |
|----------|-------|-------|---|
| 1. | 0.1 M | 0.1 M | 6.0×10^{-3} M min ⁻¹ |
| 2. | 0.3 M | 0.2 M | 7.2×10^{-3} M min ⁻¹ |
| 3. | 0.3 M | 0.4 M | 2.88×10^{-2} M min ⁻¹ |
| 4. | 0.4 M | 0.1 M | 2.40×10^{-2} M min ⁻¹ |
- Determine rate law and the rate constant for the reaction.
- Delhi 2010C
4. Derive rate constant equation for first order reactions.
- Tamil Nadu Board-2011
5. (a) Derive the units of rate constants K for the first and second order reaction.
 (b) Define molar conductivity. How molar conductivity varies with concentration ?
 (c) Define solubility product (K_{sp}) and solubility equilibrium.
- NIOS Board-2021
6. (a) The initial concentration of N_2O_5 in the following first order reaction $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ was 1.24×10^{-2} mol L⁻¹ at 318 K. The concentration of N_2O_5 after 60 minutes was 0.2×10^{-2} mol L⁻¹. Calculate the rate constant of the reaction at 318 K.
 (b) The pH of a sample of rain water at 25°C is 5. Find the concentration of hydronium ion in it.
- NIOS Board-2019
7. Explain the experimental determination of rate constant for the decomposition of H_2O_2 in aqueous solution.
- Tamil Nadu Board-2018
8. (i) The unit of rate constant of a chemical reaction is $L^2 mol^{-2}s^{-1}$. Calculate order of the reaction.
 (ii) The rates of a first order reaction after 10 mins and 20 mins from the commencement of the reaction are 0.04 mol L⁻¹s⁻¹ and 0.03 mol L⁻¹s⁻¹ respectively. Calculate half-life period of the reaction.
- West Bengal Board-2019
9. Rate of a reaction is the change in concentration of any one of the reactants or any one of the products in unit time
 (a) Express the rate of the following reaction in terms of reactants and products
 $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$
- (b) (i) $N_2O_{5(g)} \rightarrow 2NO_{2(g)} + \frac{1}{2}O_{2(g)}$ is a first order reaction. Find the unit of K.
 (ii) Calculate the time required for the completion of 90% of a first order reaction. ($K=0.2303s^{-1}$)
- Kerala Board-2016
10. For the reaction $2H_2 + 2NO \rightleftharpoons 2H_2O + N_2$, the following rate data was obtained:
- | S.No | [NO]mol L ⁻¹ | [H ₂]mol L ⁻¹ | Rate; mol L ⁻¹ sec ⁻¹ |
|------|-------------------------|--------------------------------------|---|
| 1 | 0.40 | 0.40 | 4.6×10^{-3} |
| 2 | 0.80 | 0.40 | 18.4×10^{-3} |
| 3 | 0.40 | 0.80 | 9.2×10^{-3} |
- Calculate the following:
- The overall order of reaction.
 - The rate law.
 - The value of rate constant (k).
- ISC Board-2017
11. Identify the reaction order from each of the following rate constants:
 (i) $k = 1.4 \times 10^{-5}$ mol⁻¹Ls⁻¹
 (ii) $k = 2.3 \times 10^{-4}$ s⁻¹
- Assam Board-2014
12. In a particular reduction process, the concentration of a solution that is initially 0.24 M is reduced to 0.12 M in 10 hours and 0.06 M in 20 hours. What is the rate constant of the reaction?
 [Given that, $\log 2 = 0.3010$]
- Jharkhand Board-2020
13. The following are the results of the three experiments carried for determination of differential rate of reaction



Initial concentration of reactants mol lit ⁻¹		Initial rate of reaction $-\frac{d[A]}{dt} \text{ mol lit}^{-1} \text{ sec}^{-1}$
[A] _o	[B] _o	
1	0.02	3.5×10^{-3}
2	0.02	1.4×10^{-2}
3	0.04	7.0×10^{-3}

- (a) Deduce the differential rate law
- (b) Calculate order of reaction and
- (c) Find out value of rate constant

Gujarat Board-2019

14. The following results have been obtained during the kinetic studies of the reaction $2A + B \rightarrow C + D$.

Experiment	[A]/mol L ⁻¹	[B]/mol L ⁻¹	Initial rate of formation of D/mol L ⁻¹ min ⁻¹
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

Determine the rate law and the rate constant for the reaction.

Gujarat Board-2020

15. For a reaction $2A \rightarrow 4B + C$, the concentration of B is increased by 5.0×10^{-3} mol L⁻¹ in 10 seconds. Calculate the rate of disappearance of A.

Assam Board-2017

16. (a) For the reaction,



The rate of formation of NO is 3.6×10^{-3} mol L⁻¹s⁻¹. Calculate the rate of disappearance of NH₃ and the rate of formation H₂O.

- (b) A certain reaction is 50% complete in 20 minutes at 300K and the same reaction is gain 50% complete in 5 minutes at 350K. Calculate the activation energy if the reaction is of first order.

Assam Board-2012

C. Order of reaction, Molecularity

Section-A : Multiple Choice Questions

1. Time taken to complete zero order reaction is _____.

- (a) $\frac{k}{[R]_0}$
- (b) $\frac{2k}{[R]_0}$
- (c) $\frac{[R]_0}{2k}$
- (d) $\frac{[R]_0}{k}$

Gujarat Board 2023 (March)

Ans. (d)

2. In reaction $A \rightarrow B$, the rate of reaction is doubled, on increasing the concentration of the reactants four times. The order of the reaction is

- (a) zero
- (b) 1/2
- (c) 2
- (d) 4

UP Board 2019

Ans. (b)

3. Expression $k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$ is integrated rate equation of order of reaction—

- (a) Zero order
- (b) First order
- (c) Second order
- (d) Third order

Rajasthan Board 2023

Ans. (b)

4. For a zero order reaction, the slope in the plot of [R] Vs. time is

- (a) $\frac{-k}{2.303}$
- (b) $-k$
- (c) $\frac{+k}{2.303}$
- (d) $+k$

(where [R] is the final concentration of reactant)

CBSE-2020

Ans. (b)

5. The unit of the rate of reaction is the same as that of the rate constant for a

- (a) first order reaction
- (b) zero order reaction
- (c) second order reaction
- (d) half-order reaction

CBSE-2020

Ans. (b)

6. In a chemical reaction $X \rightarrow Y$, it is found that the rate of reaction doubles when the concentration of X is increased four times. The order of the reaction with respect to X is

- (a) 1
- (b) 0
- (c) 2
- (d) 1/2

CBSE-2020

Ans. (d)

7. The reaction between X and Y is first order with respect to X and second order with respect to Y. If the concentration of X is halved and the concentration of Y is doubled, the rate of reaction will be

- (a) same as the initial value
- (b) three times the initial value
- (c) double the initial value
- (d) half the initial value

ISC Board-2008

Ans. (d)

8. The order reaction for following value of rate constant is.....

$$K = 2.3 \times 10^{-5} \text{ L, Mol}^{-1} \text{ Sec}^{-1}$$

- (a) First order
- (b) Zero order
- (c) Second order
- (d) Third order

Gujarat Board-2021

Ans. (c)

9. A first order reaction if found to have a rate constant, $K = 5.5 \times 10^{-14} \text{ S}^{-1}$. The half life of reaction is
 (a) $1.26 \times 10^{13} \text{ S}$ (b) $1.26 \times 10^{14} \text{ S}$
 (c) $6.93 \times 10^{14} \text{ S}$ (d) $12.6 \times 10^{15} \text{ S}$

Gujarat Board-2021

Ans. (a)

10. For the reaction, $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$, the reaction rate = $K[\text{H}_2][\text{Br}_2]^{1/2}$; the statement that is true about this reaction is
 (a) the reaction is of second order
 (b) the order of the reaction is 3/2
 (c) the unit of K is s^{-1}
 (d) the molecularity of the reaction is 3/2

Goa Board-2023

Ans. (b)

11. (a) When two reactants, A and B are mixed to give products C and D, the reaction quotient, Q at the initial stages of the reaction:
 (a) Is zero
 (b) Decreases with time
 (c) Is independent of time
 (d) Increases with time

Odisha Board-2017

Ans. (d)

12. For an initial reaction, which of the following is correct
 (a) Order of reaction = molecularity
 (b) Order of reaction \neq molecularity
 (c) Order of reaction $>$ molecularity
 (d) Order of reaction $<$ molecularity

Gujarat Board-2019

Ans. (a)

13. Photochemical combination of H_2 and Cl_2 to form HCl when carried out over water is a reaction of:
 (a) First order (b) Zero order
 (c) Second order (d) 1.5 order

NIOS Board-2023

Ans. (b)

14. Identify the order of reaction from the given rate constant:

$$K = 1.6 \times 10^{-6} \text{ L mol}^{-1} \text{ S}^{-1}$$

- (a) Zero (b) First
 (c) Second (d) None of these

Haryana Board-2022

Ans. (c)

15. Identify the order of reaction from given rate constant $K = 2.6 \times 10^{-4} \text{ mol L}^{-1} \text{ S}^{-1}$
 (a) First (b) Zero
 (c) Second (d) None of these

Haryana Board-2021

Ans. (c)

16. Which of the following correctly represents integrated rate law equation for a first order reaction in gas phase :

$$(a) k = \frac{2.303}{t} \times \log_{10} \frac{P_i}{P_i - P}$$

$$(b) k = \frac{2.303}{t} \times \log_{10} \frac{P_i}{2P_i - P}$$

$$(c) k = \frac{2.303}{t} \times \log_{10} \frac{2P_i}{P_i - P}$$

$$(d) k = \frac{2.303}{t} \times \log_{10} \frac{P_i - P}{2P_i}$$

Maharashtra board-2023

Ans. (b)

17. Rate = $K[\text{H}_2\text{O}_2]$ is an example of

- (a) zero order reaction
 (b) first order reaction
 (c) second order reaction
 (d) none of these

Jharkhand Board-2019

Ans. (b)

18. An example of trimolecular reaction is

- (a) $\text{N}_2\text{O}_5 \rightarrow 2\text{NO}_2 + \frac{1}{2}\text{O}_2$
 (b) $2\text{NI} \rightarrow \text{H}_2 + \text{I}_2$
 (c) $2\text{NO} + \text{Br}_2 \rightarrow 2\text{NOBr}$
 (d) None of these

Jharkhand Board-2020

Ans. (c)

19. Time required for 100% completion of a zero order reaction is:

- (a) $t_{100\%} = a/k$ (b) $t_{100\%} = a.k$
 (c) $t_{100\%} = a/2k$ (d) None of these

Haryana Board-2017

Ans. (a)

20. The molecularity of the reaction $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$ is ,

- (a) 5 (b) 2
 (c) 3 (d) 0

Kerala Board-2016

Ans. (c)

21. The molality of pure water is:

- (a) 20 (b) 18
 (c) 10 (d) 55.5

Haryana Board-2018

Ans. (d)

22. For a Reaction $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ the rate of reaction with respect to NH_3 will be?

- (a) $-\frac{d[\text{NH}_3]}{dt}$ (b) $-\frac{d[\text{NH}_3]^2}{dt}$
 (c) $+\frac{1}{2} \frac{d[\text{NH}_3]}{dt}$ (d) $-\frac{1}{2} \frac{d[\text{NH}_3]}{dt}$

Haryana Board-2018

Ans. (c)

Haryana Board-2018

Ans. (a)

24. Hydrolysis of an ester by dilute HCl is an example for:

 - (a) second order reaction
 - (b) zero order reaction
 - (c) pseudo first order reaction
 - (d) first order reaction

Tamilnadu Board, Sep.-2016

Ans. (c)

- 25. Whose value from the given below can never be a fraction for a chemical reaction?**

(a) rate constant (b) half life period
(c) molecularity (d) order of reaction

Gujarat Board-2016

Ans. (c)

26. What is the value of intercept for the graph of $\log[R] \rightarrow$ time for the first order reaction?

(a) $\log[R]_0$ (b) $\ln[R]_0$
(c) $-K/2.303$ (d) $K/2.303$

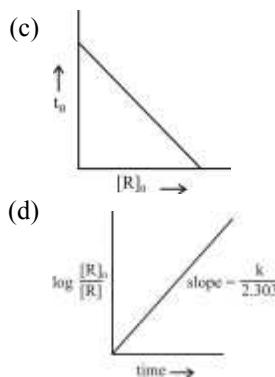
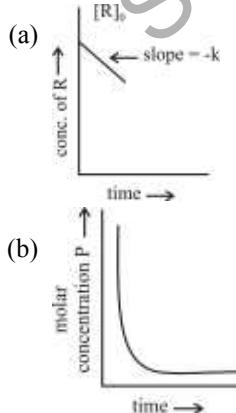
Gujarat Board-2017

Ans. (a)

Gujarat Board-2018

Ans. (b)

28. Which of the following graph is correct for a first order reaction?



Gujarat Board-2020

Ans. (d) :

29. A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is reduced to half?

- (a) 2 times (b) $\frac{1}{2}$ times
 (c) 4 times (d) $\frac{1}{4}$ times

Gujarat Board-2020

Ans. (d)

- Unit of rate constant of zero order reaction**

(d) E-Mer-3
Haryana Board-2016

Ans. (a)

Section-B : Very Short Answer

31. Explain shape selective catalysis by zeolite
Gujarat Board 2023 (March)

32. Explain pseudo first order reaction.
Gujarat Board 2022 (July)

33. Order of reaction is , when $K = 3 \times 10^{-4} \text{ s}^{-1}$.
Haryana Board 2023

34. Write the integrated rate equation for a first order reaction and explain the terms in it.
Kerala Board 2023

35. (i) What are Pseudo first order reactions?
(ii) Write one example for pseudo first order reaction.
Kerala Board 2023

36. The unit of rate constant of a zero order chemical reaction is _____.
Kerala Board 2023

37. Why molecularity is applicable only for elementary reactions and order is applicable for elementary as well as complex reactions?
Manipur Board 2020

38. Draw labeled diagram of electro-dialysis.
Rajasthan Board 2023

39. Fill in the blank:
The solubility of gas in liquid is directly proportional to the of the gas.
Uttarakhand Board 2023

40. Write the molecularity of reaction $2\text{HI} \rightarrow \text{H}_2 + \text{I}_2$
Uttarakhand Board 2023
41. Write the slope value obtained in the plot of $\log [\text{R}_0]/[\text{R}]$ Vs. time for a first order reaction.
CBSE-2020
42. Write the slope value obtained in the plot of $\ln[\text{R}]$ vs. time for a first order reaction.
CBSE-2020
43. A reaction is first order w.r.t. reactant A as well as w.r.t reactant B. Give the rate law. Also give one point of difference between average rate and instantaneous rate.
CBSE-2020
44. Calculate the overall order of the reaction whose rate law expression was predicted as :
 $\text{Rate} = k[\text{NO}]^{3/2}[\text{O}_2]^{1/2}$
CBSE-2020
45. Analyse the given graph, drawn between concentration of reactant vs. time.
-
- (a) Predict the order of reaction.
(b) Theoretically, can the concentration of the reactant reduce to zero after infinite time? Explain.
CBSE-2020
46. A particular reaction is first order in A and second order in A. Write the differential rate equation. How is the rate affected when.
(a) Concentration of B is tripled, and
(b) Concentrations of both A and B are doubled?
CBSE-2020
47. For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction. ($\log 10 = 1$)
CBSE-2021
48. The reaction between A and B is first order with respect to A and zero order with respect to B. For this reaction, fill in the blanks in the following table:
- | Experiment | [A]/M | [B]/M | Initial rate M/min |
|------------|-------|-------|----------------------|
| I | 0.1 | 0.1 | 2.0×10^{-2} |
| II | — | 0.2 | 4.0×10^{-2} |
| III | 0.4 | 0.4 | — |
| IV | — | 0.2 | 2.0×10^{-2} |
- CBSE-2022**
49. Write two differences between Order of reaction and Molecularity of reaction.
CBSE-2022
50. A first order reaction is 25% complete in 30 minutes. Calculate the value of rate constant and $t_{1/2}$. [$\log 2 = 0.3010$, $\log 4 = 0.6021$, $\log 3 = 0.4771$]
CBSE-2022
51. A reaction is first order in X and second order in Y.
(i) How is the rate affected on increasing the concentration of Y three times?
(ii) How is the rate affected when the concentrations of both X and Y are doubled?
CBSE-2022
52. In a reaction $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$, the concentration of N_2O_5 decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the average rate of this reaction and rate of production of NO_2 during this period.
CBSE-2022
53. What do you mean by complex reactions ? Can we determine order and molecularity of a complex reaction ?
CBSE-2022
54. (a) For a reaction $\text{R} \rightarrow \text{P}$, half life ($t_{1/2}$) is independent of the initial concentration of reactants. What is the order of the reaction ?
(b) Write one difference between order and molecularity of a reaction.
CBSE-2022
55. Give two examples for zero order reactions.
Telangana Board-2017
56. Show that for a first order reaction, time required for completion of 99% of reaction is twice the time required for completion of 90% of reaction.
CBSE-2019
57. Define order of reaction. Predict the order of reaction in the given graphs:
- (a)
- (b)
- where $[\text{R}]_0$ is the initial concentration of reactant and $t_{1/2}$ is half-life.
CBSE-2019
58. The decomposition of NH_3 on platinum surface is zero order reaction. If rate constant (k) is $4 \times 10^{-3} \text{ Ms}^{-1}$, how long will it take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M .
CBSE-2019

59. The rate constant of a first order reaction increases from 2×10^{-2} to 6×10^{-2} when the temperature changes from 300 K to 320 K. Calculate the energy of activation. (Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$)
CBSE-2019
60. Rate constant for a first order reaction has been found to be $2.54 \times 10^{-3} \text{ s}^{-1}$. Calculate its three-fourth life. [Given : $\log = 0.3010$]
CBSE-2019
61. A first order reaction takes 30 minutes for 50% completion the time required for 90% completion.[Given : $\log 2 = 0.3010$]
CBSE-2019
62. (a) Define order of reaction. How does order of a reaction differ from molecularity for a complex reaction ?
(b) A first order reaction is 50% complete in 25 minutes. Calculate the time for 80% completion of the reaction.
CBSE-2019
63. What is the difference between order of a reaction and the molecularity of a reaction ?
ISC Board-2017, 2015
64. Define molecularity of a reaction. Give one difference between the order of a reaction and its molecularity.
ISC Board-2007
65. Correct the following statements by changing the underlined part of the sentence.
(Do not change the whole sentence.)
The rate constant of a first order reaction is directly proportional to the concentration of the reactant.
ISC Board-2008, 2004
66. For a first order reaction, the unit of rate is....and that of rate constant is....
ISC Board-2011
67. Name the order of reaction which proceeds with a uniform rate throughout.
ISC Board-2017
68. A first order reaction is 20% completed in 5 min. Calculate the time taken for the reaction to be 60% complete.
All India 2009C
69. A first order reaction has a rate constant value of 0.00510 min^{-1} . If we begin with 0.10 M concentration of the reactant, how much of the reactant will remain after 3.0 h?
Foreign 2011, 2009;
Delhi 2009; All India 2009
70. The thermal decomposition of HCOOH is a first order reaction with a rate constant of $2.4 \times 10^{-3} \text{ s}^{-1}$ at a certain temperature. How long will it take for three fourth of initial quantity of HCOOH to decompose? ($\log 0.25 = -0.6021$)
All India 2011
71. A first order reaction takes 100 min for completion of 60% of the reaction. Find the time when 90% of the reaction will be completed.
Delhi 2013C
72. Show that for a first order reaction, the time required for half the change (half-life period) is independent of initial concentration.
Delhi 2009C
73. A reactant has a half-life of 10 min.
(i) calculate the rate constant for the first order reaction.
(ii) What fraction of the reactant will be left occurred?
All India 2011C
74. What are pseudo first order reactions? Given one example of such reactions.
All India 2011
75. For a chemical reaction, $R \rightarrow P$, the variation in the concentration of R versus time (t) plot is given as
-
- (i) Predict the order of the reaction.
(ii) What is the slope of the curve?
Delhi 2014
76. Hydrogen peroxide, $H_2O_2(aq)$ decomposes to $H_2O(l)$ and $O_2(g)$ in a reaction that is first order in H_2O_2 and has a rate constant $k = 1.06 \times 10^{-3} \text{ min}^{-1}$.
(i) How long will it take for 15% of a sample of H_2O_2 to decompose?
(ii) How long will it take for 85% of the sample to decompose?
Delhi 2014, Foreign 2009
77. Explain the term order of reaction. Derive the unit for first order rate constant.
Delhi 2009C
78. What is meant by rate constant, k of a reaction? If the concentration be expressed in mol L⁻¹ units and time in seconds, what would be the unit of k
(i) for a zero order reaction and
(ii) for a first order reaction?
Delhi 2008; Foreign 2008
79. The decomposition of NH_3 on platinum surface is a zero order reaction. What are the rates of production of N_2 and H_2 if $k = 2.5 \times 10^{-4} \text{ mol L}^{-1} s^{-1}$?
Delhi 2008; All India 2008; foreign 2008
80. Define
(i) Order of reaction
(ii) Elementary step in a reaction.
Foreign 2011
81. List two main differences between order of a reaction and molecularity of a reaction.
Delhi 2011C
82. Distinguish between molecularity and order of a reaction.
All Indian 2010
Delhi 2008C

83. Identify giving reasons, the reaction order from each of the following rate constants.
 (i) $k = 2.3 \times 10^{-5} \text{ L mol}^{-1} \text{ s}^{-1}$
 (ii) $k = 3.0 \times 10^{-4} \text{ s}^{-1}$
- Delhi 2011C
84. Explain the following terms.
 (i) Rate determining step of a reaction.
 (ii) Molecularity of a reaction.
- All India 2011C, 2010
85. A reaction is of first order in reactant A and of second order in reactant B. How is the rate of this reaction affected when
 (i) the concentration of B alone is increased to three times?
 (ii) the concentrations of A as well as B are doubled?
- Delhi 2010
86. What do you understand by the rate law and rate constant of a reaction? Identify the order of a reaction, if the units of its rate constant are
 (a) $\text{L}^{-1} \text{ mol s}^{-1}$. (b) $\text{L mol}^{-1} \text{ s}^{-1}$.
- Delhi 2014C, Delhi 2012; All India 2011
87. Write units of rate constants for zero order and for the second order reactions if the concentration is expressed in mol L^{-1} and time in seconds.
- All India 2015C
88. Write two differences between 'order of reaction' and 'molecularity of reaction'.
- All India 2014
89. (i) For a reaction, $\text{A} + \text{B} \rightarrow \text{Product}$, The rate law is given by,
 $\text{Rate} = k [\text{A}]^1 [\text{B}]^2$. What is the order of the reaction?
 (ii) Write the unit of rate constant 'k' for the first order reaction.
- Delhi 2014C
90. A reaction is of second order with respect to a reactant. How is its rate affected if the concentration of the reactant is
 (i) doubled?
 (ii) reduced to half?
- Delhi 2014C; All India 2012;
 Delhi 2009; Foreign 2009, 2008
91. For a reaction : $\text{H}_2 + \text{Cl}_2 \xrightarrow{\text{hv}} 2\text{HCl}$
 $\text{Rate} = k$
 (i) Write the order and molecularity of this reaction.
 (ii) Write the unit of k.
- All India 2016C
92. For a reaction,
 $2\text{NH}_3(\text{g}) \xrightarrow{\text{Pt}} \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$
 $\text{Rate} = k$
 (i) Write the order and molecularity of this reaction.
 (ii) Write the unit of k.
- Delhi 2016
93. Define order of a reaction.
 Foreign 2012, All India 2011, 2010, 2009, 2008
 Delhi 2011C, 2010, 2008C
94. Identify the reaction order from the following rate constant,
 $k = 2.3 \times 10^{-5} \text{ L mol}^{-1} \text{ s}^{-1}$.
- Delhi 2011
95. For a reaction $\text{R} \rightarrow \text{P}$, half-life ($t_{1/2}$) is observed to be independent of the initial concentration of reactions. What is the order of reaction?
- Delhi 2017
96. For a reaction $\text{A} + \text{B} \rightarrow \text{P}$, the rate law is given by, $r = k[\text{A}]^{1/2} [\text{B}]^2$. What is the order of this reactions?
- All India 2013
97. Define molecularity and order of reaction. Derive an expression for the rate constant of a zero-order reaction.
- Odisha Board-2020
98. The half-life period of a first order reaction is 30 minutes. How much time is required for 75% completion of the reaction? ($\log 2 = 0.301$)
- Odisha Board-2020
99. For the first order reaction the rate constant is $4.62 \times 10^{-2} \text{ s}^{-1}$. What will be the time required for the initial concentration 1.5 mol of the reactant to be reduced to 0.75 mol? [$\log 2 = 0.3010$]
- Manipur Board-2018
100. Give an example of zero-order reaction.
- Karnataka Board-2014
101. Identify the order of the reaction from the rate constant $k = 2.3 \times 10^{-6} \text{ L mol}^{-1} \text{ s}^{-1}$.
- Karnataka Board-2020
102. What is pseudo first order reaction? Give an example.
- Karnataka Board-2019
103. From the following graph, identify order of reaction and mention the unit of its rate.
- Karnataka Board-2017
104. What happens to the half life period for a first order reaction, if the initial concentration of the reactants is increased?
- Karnataka Board-2016
105. Define collision frequency. Give an example for Pseudo-first order reaction.
- Karnataka Board-2014
106. For the reaction $2\text{HI} \rightarrow \text{H}_2 + \text{I}_2$ write its molecularity.
- Karnataka Board-2014
107. Give two examples for zero order Reaction.
- Andhra Pradesh Board-2019
108. Find the half life period of first order reaction whose rate constant $K = 4.93 \times 10^{-4} \text{ S}^{-1}$.
- Punjab Board-2019
109. A first order reaction is 20% complete in 20 minutes. Calculate the time it will take the reaction to complete 80%.
- Punjab Board-2017
110. Define order of reaction,
- Punjab Board-2017

- 111.(i)Zero order reaction means that the rate of a reaction is independent of the concentration of reactants.
 a) Write an example for a zero order reaction.
 b) Write the integral rate expression for the zero order reaction, $R \rightarrow P$.
- (ii) The temperature dependence of the rate of a chemical reaction can be accurately explained by Arrhenius equation. With the help of Arrhenius equation calculate the rate constant for the first order reaction $C_2H_5I_{(g)} \rightarrow C_2H_4_{(g)} + HI_{(g)}$ at 700 K. Energy of activation (E_a) for the reaction is 209 kJ mol⁻¹ and rate constant at 600 K is 1.60×10^{-5} S⁻¹ [Universal gas constant $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$]
- Kerala Board-2013
112. If $K = \frac{0.693}{t_{1/2}}$ the order of reaction will be

- Haryana Board-2022
113. Is it possible that Molecularity of reaction can be zero?

- Haryana Board-2022
114. Identify the reaction order from the following rate constant :
 $k = 3.5 \times 10^{-5} \text{ Lmol}^{-1} \text{ s}^{-1}$.

- Haryana Board-2019
115. Derive the integrated rate equation for a first order reaction.

- Goa Board-2018
116. For the reaction $2HI \rightarrow H_2 + I_2$, what is the order of reaction ?

- Jharkhand Board-2018
117. Give the units of First and Zero order reaction.

- J&K Board-2019
118. What is the order for the reaction
 $2NH_{3(g)} \xrightarrow[\text{Pt.Catalyst}]{1130k} N_{3(g)} + 3H_{(g)}$ at high pressure?

- Karnataka Board-2020
119. In a zero order reaction, the time taken to reduce the concentration of reactant from 50% to 25% is 30 minutes. What is the time required to reduce the concentration from 25% to 12.5%?

- Karnataka Board-2015
120. Rate constant of a reaction is
 $k = 3.4 \times 10^{-4} \text{ mol}^{-1} \text{ LS}^{-1}$. What is the order of the reaction?

- Karnataka Board-2016
121. Rate constant of a reaction $A \rightarrow B$ increases two times by increasing the concentration 'A' by four times, what is the order of a reaction?

- Karnataka Board-2017
122. A chemical reaction has the rate expression Rate = $K[A]^2 [B]$. What is overall order?

- Karnataka Board-2018
123. Give an example for pseudo first order reaction.

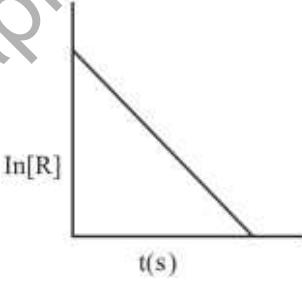
- Karnataka Board-2019
124. What is zero-order reaction ? Write also the formula.

- Chhattisgarh Board-2022
125. Write only the mathematical expression used to calculate the activation energy of a chemical reaction at two different temperatures.
 Starting from the integrated rate law equation for a first order reaction, derive the expression for its half life.
- Goa Board-2019
126. Define order of reaction and molecularity of reaction. Write the differences between them.

- Andhra Pradesh Board-2021
127. Write the integrated equation for a first order reaction in terms of $[R]$, $[R]_0$ and 't',

- Andhra Pradesh Board-2021
128. A first order reaction is founded to have a rate constant, $k = 5.5 \times 10^{-14} \text{ s}^{-1}$. Find out the half - life of the reaction.

- Kerala Board-2016
129. Write the unit of velocity constant for second order reaction.

- Rajasthan Board-2017
130. For a certain chemical reaction variation in the concentration in $[R]$ vs time (s) plot is given below.
- 
- For this reaction
- (i) What is the order of the reaction?
 - (ii) What is the unit of rate constant k?
 - (iii) Write the relationship between k and $t_{1/2}$.
 - (iv) What does the slope of the above line indicate?
- Assam Board-2020
131. The rate constant for a chemical reaction at a given temperature is $23 \times 10^{-5} \text{ L mol}^{-1} \text{ s}^{-1}$. What is the order of the reaction?

- Assam Board-2018
132. (a) The rate of a reaction is equal to rate constant of the reaction. Mention the order of the reaction.

- Assam Board-2016

Section-C : Short Answer

1. The rate constant for the first order decomposition of N_2O_5 is given by the following equation :

$$k = (2.5 \times 10^{14} \text{ s}^{-1}) e^{(-25000K)/T}$$

 Calculate E_a for this reaction and rate constant if its half-life period be 300 minutes.

CBSE-2020

2. A first order reaction is 40% complete in 80 minutes. Calculate the value of rate constant (k). In what time will the reaction be 90% completed ?

[Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$, $\log 5 = 0.6771$, $\log 6 = 0.7782$]

CBSE-2020

3. A first order reaction takes 30 minutes for 60% decomposition. Calculate $t_{1/2}$.

[Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$, $\log 10 = 1$]

CBSE-2021

4. (a) A reaction is second order in X and first order in Y. How is the rate affected when the concentrations of both X and Y are doubled ?

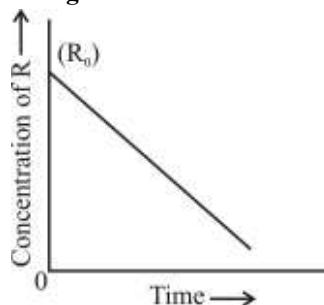
(b) Write the units of 'k' for

(i) Zero order reaction

(ii) First order reaction

CBSE-2022

5. (a) The variation in the concentration (R) vs. time (t) plot is given below. Answer the following questions on the basis of the given figure :



(i) Predict the order of the reaction.

(ii) What is the slope of the curve ?

(iii) What are the units of the rate constant k ?

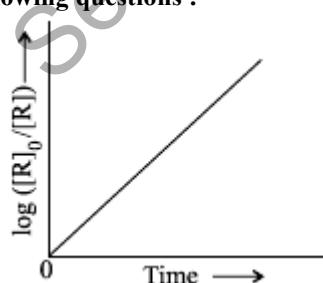
OR

- (b) A first order reaction takes 24 minutes for 50% decomposition. Calculate the time required for 25% decomposition.

(Given : $\log 4 = 0.6021$, $\log 3 = 0.4771$)

CBSE-2022

6. Observe the graph shown in figure and answer the following questions :



(a) What is the order of the reaction ?

(b) What is the slope of the curve ?

(c) Write the relationship between k and $t_{1/2}$ (half life period)

CBSE-2022

Answer the following questions (Do any two) :

(a) Identify the order of reaction from the following unit for its rate constant : $\text{Lmol}^{-1}\text{s}^{-1}$

(b) The conversion of molecules A to B follow second order kinetics. If concentration of A is increased to three times, how will it affect the rate of formation of B ?

(c) Write the expression of integrated rate equation for zero order reaction.

CBSE-2022

The reaction between A and B is first order with respect to A and zero order with respect to B. For this reaction, fill in the blanks in the following table.

Experiment	$[\text{A}] \text{ mol/L}$	$[\text{B}] \text{ mol/L}$	Initial Mol/L/min	Rate
I	0.1	0.1	2.0×10^{-2}	
II	-	0.2	4.0×10^{-2}	
III	0.4	0.4	-	
IV	-	0.2	2.0×10^{-2}	

CBSE-2019

The following data were obtained for the reaction :



Experiment	$[\text{A}] / \text{M}$	$[\text{B}] / \text{M}$	Initial rate of formation of $\text{C}/\text{M min}^{-1}$
1	0.2	0.3	4.2×10^{-2}
2	0.1	0.1	6.0×10^{-3}
3	0.4	0.3	1.68×10^{-1}
4	0.1	0.4	2.40×10^{-2}

(a) Find the order of reaction with respect to A and B.

(b) Write the rate law and overall order of reaction.

(c) Calculate the rate constant (k).

CBSE-2019

10. The decomposition of NH_3 on platinum surface is zero order reaction. If rate constant (k) is $4 \times 10^{-3} \text{ Ms}^{-1}$, how long will it take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M.

CBSE-2019

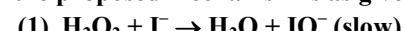
11. The decomposition of NH_3 on platinum surface is zero order reaction. If rate constant (k) is $4 \times 10^{-3} \text{ Ms}^{-1}$, how long will it take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M.

CBSE-2019

12. For a reaction



the proposed mechanism is as given below :



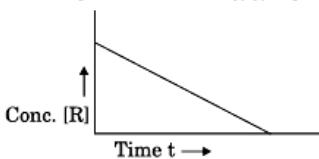
(i) Write rate law for the reaction.

(ii) Write the overall order of reaction.

(iii) Out of steps (1) and (2), which one is rate determining step ?

CBSE-2019

13. (a) Consider the reaction $R \rightarrow P$ for which the change in concentration of R with time is shown by the following graph :



- (i) Predict the order of reaction.
(ii) What does the slope of the curve indicate?
(b) The rate of reaction quadruples when temperature changes from 293 K to 313 K. Calculate E_a assuming that it does not change with time. $[R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}]$

CBSE-2019

14. (a) Draw the plot of $\ln k$ vs $1/T$ for a chemical reaction. What does the intercept represent? What is the relation between slope and E_a ?
(b) A first order reaction takes 30 minutes for 20% decomposition. Calculate $t_{1/2}$. $[\log 2 = 0.3010]$

CBSE-2019

15. In a first order reaction, 10% of the reactant is consumed in 25 min. Calculate
(i) half-life of the reaction.
(ii) the time required for completing 17% of the reaction.

ISC Board-2013

16. A first order reaction is 50% complete in 30 min at 27°C. Calculate the rate constant of the reaction at 27°C.

ISC Board-2000

17. Show that the time required for the completion of 75% of a reaction of first order is twice the time required for the completion of 50% of the reaction.

ISC Board-2010

18. A substance decomposes by the following first order kinetics. If 50% of the compound is decomposed in 120 min, how long will it take for 90% of the compound to decompose ?

ISC Board-2015

19. For the reaction :
 $2\text{H}_2 + 2\text{NO} \rightleftharpoons 2\text{H}_2\text{O} + \text{N}_2$ the following rate data was obtained :

S.No.	$[\text{NO}] \text{ mol L}^{-1}$	$[\text{H}_2] \text{ mol L}^{-1}$	Rate : $\text{mol L}^{-1} \text{ sec}^{-1}$
1	0.40	0.40	4.6×10^{-3}
2	0.80	0.40	18.4×10^{-3}
3	0.40	0.80	9.2×10^{-3}

Calculate the following

- (a) The overall order of reaction
(b) The rate law
(c) The value of rate constant (k).

ISC Board-2017

20. A study of chemical kinetics of the reaction $A + B \rightarrow \text{products}$, gave the following data at 25°C.

Experiment	[A]	[B]	$\frac{d(\text{Product})}{dt}$
1.	1.0	0.15	4.20×10^{-6}
2.	2.0	0.15	8.40×10^{-6}
3.	1.0	0.20	5.60×10^{-6}

Find

- (i) The order of reaction with respect to A
(ii) The order of reaction with respect to B
(iii) The rate law.

ISC Board-2012

21. The initial rate of a reaction, $A + B \rightarrow \text{products}$, is doubled when the initial concentration of A is doubled and increases eight fold when the initial concentration of both A and B were doubled. State the order of the reaction with respect to A and with respect to B. Write the rate equation.

ISC Board-2004

22. Nitrogen pentoxide decomposes according to the equation
 $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$
This first order reaction was allowed to proceed at 40°C and the data below were collected.

$[\text{N}_2\text{O}_5] \text{ M}$	Time (min)
0.400	0.00
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

- (i) Calculate the rate constant. Include units with your answer.

- (ii) Calculate the initial rate of reaction.

Delhi 2021

23. A reaction is second order wrt A and first order wrt B.

- (i) Write the differential rate equation.
(ii) How is the rate affected on increasing the concentration of A three times?
(iii) How is the rate affected when the concentration of both A and B are doubled?

HOTS; Delhi 2013

24. What do you understand by order of reaction? Give an example of a reaction of first order. How order of reaction differs from molecularity?

Uttarakhand Board-2020

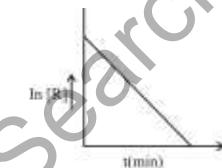
25. What is activation energy? How is the rate constant of a reaction related to its activation energy?

Uttarakhand Board-2020

26. Write two differences between order of reaction and molecularity.
- Gujarat Board-2021
27. Write only the mathematical expression used to calculate the activation energy of a chemical reaction at two different temperatures. Starting from the integrated rate law equation for a first order reaction, derive the expression for its half life.
- Goa Board-2023
28. (a) Define order and molecularity of a reaction. Derive an expression for the rate constant of a first order reaction.
 (b) If a first order reaction is 20% completed in 10 minutes, how long will it take for 75% completion.
- Odisha Board-2023
29. (a) Define order of a reaction.
 (b) State one condition under which a bimolecular reaction may kinetically be of first order reaction citing a suitable example.
 (c) Give the unit of rate constant for zero order reaction.
- Manipur Board-2018
30. Write any two characteristics of first order reaction.
- Tamil Nadu Board-2018
31. Identify the reaction order from each of the following rate constants:
 (a) $K = 2.3 \times 10^{-5} \text{ L mol}^{-1} \text{ s}^{-1}$
 (b) $K = 3 \times 10^{-4} \text{ s}^{-1}$
- Andhra Pradesh Board-2020
32. Differentiate between order and molecularity of reaction.
- Jharkhand Board-2018
33. The reaction $A + B \rightarrow$ products is first order in each of the reactants,
 (a) How does the rate of reaction change if the concentration of A is increased by factor 3?
 (b) What is the change in the rate of reaction if the concentration of A is halved and concentration of B is doubled?
- Maharashtra board-2018
34. A certain reaction occurs in the following steps:
 (a) $\text{Cl}_{(g)} + \text{O}_{3(g)} \rightarrow \text{ClO}_{(g)} + \text{O}_{2(g)}$
 (b) $\text{ClO}_{(g)} + \text{O}_{(g)} \rightarrow \text{Cl}_{(g)} + \text{O}_{2(g)}$
 (1) What is the molecularity of each of the elementary steps?
 (2) Identify the reaction intermediate and write the chemical equation for overall reaction
- Maharashtra board-2018
35. Explain Pseudo-first order reaction with suitable example.
- Maharashtra board-2022
36. What is Pseudo first order reaction? Derive integrated rate law equation for zero order reaction.
- Maharashtra board-2023
37. What is a zero order reaction? Give the unit of rate constant for zero order reaction.
- Kerala Board-2021
38. For hydrolysis of methyl acetate in aqueous solution, the following results were observed
- | t/s | 0 | 30 | 60 |
|-----------------------------|------|------|------|
| $\text{CH}_3\text{COOCH}_3$ | 0.60 | 0.30 | 0.15 |
| C/mol L^{-1} | | | |
- Show that it follows pseudo first order reaction as the concentration of water remains constant.
- Kerala Board-2018
39. What is the difference between the order of a reaction and its molecularity?
- ISC Board-2017
40. Name the order of reaction which proceeds with a uniform rate throughout
- ISC Board-2017
41. Identify the order of reaction from each of the following units of rate constant (k):
 (a) $\text{mol L}^{-1} \text{ sec}^{-1}$
 (b) $\text{mol}^{-1} \text{ L sec}^{-1}$
- ISC Board-2017
42. For a reaction $A + B \rightarrow C + D$, the rate equation is, rate = $K[A]^{3/2}[B]^{1/2}$. Give the overall order and molecularity of reaction.
- Kerala Board-2020
43. Find the molecularity and order of reaction of the following reaction:
- Chhattisgarh Board-2020
44. The conversion of molecule A to B follows second order kinetics. If concentration of A is increased four times how will the rate of formation of B be affected?
- Assam Board-2014
45. A reaction is of second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is doubled?
- Jharkhand Board-2020
46. A 1st order reaction has $k = 1.15 \times 10^{-3} \text{ s}^{-1}$. How long will 5 gm of this reactant take to reduce to 3 gm?
- Haryana Board-2017
47. The terms order and molecularity are common in chemical kinetics.
 (a) What do you mean by order and molecularity?
 (b) (i) Write two factors influencing rate of a reaction.
 (ii) Write Arrhenius equation.
- Kerala Board-2015
48. Write any two differences between order of reaction and molecularity.
- Rajasthan Board-2020
49. A first order reaction takes 40 minute for 20% decomposition. Calculate half life. ($\log_{10}2 = 0.3010$)
- Rajasthan Board-2019
50. Show that, in a first order reaction, time required for completion of 99.9% is 10 times of half life. ($\log_{10}1 =$)
- Rajasthan Board-2018

51. Write definition of molecularity of reaction.
Rajasthan Board-2018
52. According to collision theory, write name of two factors which increases the rate of reaction as temperature increase.
Rajasthan Board-2018
53. Write definition of order of reaction.
Rajasthan Board-2018
54. Explain denaturation of protein with an example.
Rajasthan Board-2015
55. Explain pseudo first order reaction by taking the example of hydrolysis of ethyl acetate.
Rajasthan Board-2013
- 56.(i) Give an example each of first and second order reactions.
(ii) Radioactive disintegration reaction is a first order reaction. Explain why.
Rajasthan Board-2011
57. (i) Explain zero order reaction by an example.
(ii) Draw a diagram related with energy and rate of chemical reaction.
Rajasthan Board-2011
58. For a reaction:

$$2\text{NH}_3(\text{g}) \xrightarrow{\text{Pt}} \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$$

Rate = k ;
(i) Write the order and molecularity of this reaction.
(ii) Write the unit of k .
Assam Board-2019
59. For a zero order reaction will the molecularity be equal to zero? Explain.
Assam Board-2019
60. Define order of a reaction.
Assam Board-2015
61. For the reaction $\text{R} \rightarrow \text{P}$, write the differential rate law.
Assam Board-2015
62. For a chemical reaction variation in concentration, $\ln[\text{R}]$ vs. time (min) plot is shown below:
- 
- (a) What is the order of the reaction?
(b) What is the unit of rate constant k , for the reaction?
(c) If initial concentration of the reactant is half of the original concentration, how will $t_{1/2}$ change?
(d) Draw the plot of $\log \frac{[\text{R}]_0}{[\text{R}]}$ vs. time (s).
Assam Board-2013
63. Write four differences between molecularity and order of reaction.
MP Board-2014
64. What is order of reaction? Write unit of rate constant K for the zero order, first order and second order reaction.
MP Board-2012
65. What is the difference between order of a reaction and its molecularity?
J&K Board-2020
66. Show that for the reaction of first order half-life period is independent of initial concentration.
J&K Board-2020
67. The inversion of cane sugar is represented by the reaction

$$\text{C}_{12}\text{H}_{22}\text{O}_{11} + \text{H}_2\text{O} \xrightarrow{\text{H}^+} \text{C}_6\text{H}_{12}\text{O}_6 + \text{C}_6\text{H}_{12}\text{O}_6$$

(Cane sugar) (excess) (Glucose) (Fructose)
(a) What is the order of this reaction?
(b) Give one condition that determines the order of this reaction.
Meghalaya Board-2021
68. Show that for the reactions of first order, half-life period is independent of initial concentrations. What is the unit of rate constant of a zero order reaction?
Assam Board-2023
69. For the first order reaction $\text{A} \rightarrow 2\text{B}$, 1 mole of reactant A gives 0.4 moles of B after 100 minutes. Calculate the half life period of the reaction.
Assam Board-2023
- 70.(a) What is the order of reaction whose rate constant has the same unit as the rate of reaction?
(b) Thermal decomposition of a compound is of first order. 50% decomposes in 120 minutes. How long will it take for 90% to decompose?
Meghalaya Board-2018
71. (a) Calculate the overall order of a reaction which has the rate expression

$$\text{Rate} = k [\text{A}]^{1/2} [\text{B}]^{3/2}$$

(b) What is the rate determining step of a reaction?
Meghalaya Board-2018

Section-D : Case Based Study

1. Read the following passage and answer the questions that follow:
The rate of reaction is concerned with decrease in concentration of reactants or increase in the concentration of products per unit time. It can be expressed as instantaneous rate at a particular instant of time and average rate over a large interval of time. A number of factors such as temperature, concentration of reactants, catalyst affect the rate of reaction. Mathematical representation of rate of a reaction is given by rate law :

$$\text{Rate} = k[\text{A}]^x [\text{B}]^y$$

 x and y indicate how sensitive the rate is to the change in concentration of A and B . Sum of $x + y$ gives the overall order of a reaction.

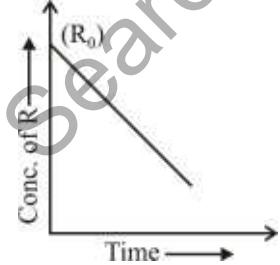
When a sequence of elementary reactions gives us the products the reactions are called complex reactions. Molecularity and order of an elementary reaction are same. zero order reactions are relatively uncommon but they occur under special conditions. All natural and artificial radioactive decay of unstable nuclei take place by first order kinetics.

- What is the effect of temperature on the rate constant of a reaction?
- For a reaction $A + B \rightarrow \text{Product}$, the rate law is given by, Rate = $k[A]^2 [B]^{1/2}$. What is the order of the reaction?
- How order and molecularity are different for complex reactions?
- A first order reaction has a rate constant $2 \times 10^{-3} \text{ s}^{-1}$. How long will 6g of this reactant take to reduce to 2g?

CBSE-2022

Section-E : Long Answer

- (a) A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy (E_a) for the reaction.
($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)
(b) Write the two conditions for collisions to be effective collisions.
(c) How order of reaction and molecularity differ towards a complex reaction?
[Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$, $\log 5 = 0.6991$]
- (a) A first order reaction is 25% complete in 40 minutes. Calculate the value of rate constant. In what time will the reaction be 80% completed?
(b) Define order of reaction. Write the condition under which a bimolecular reaction follows first order kinetics.
- (a) Visha plotted a graph between concentration of R and time for a reaction $R \rightarrow P$. On the basis of this graph, answer the following questions:



- Predict the order of reaction.
- What does the slope of the line indicate?
- What are the units of rate constant?
- A first order reaction takes 25 minutes for 25% decomposition. Calculate $t_{1/2}$.
[Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$]

CBSE-2020

4. Following data were obtained for the given reaction:

X + Y \longrightarrow Product			
Exp.	[X]/M	[Y]/M	Initial Rate M min ⁻¹
1	0.1M	0.2M	0.05
2	0.2M	0.2M	0.10
3	0.1M	0.1M	0.05

- Find the order of reaction with respect to X and Y.
- Write the rate law expression.
- Find the rate constant.

CBSE-2021

- Consider the reaction,
 $A + B \rightarrow C + D$
The initial rates for different initial concentrations of the reactants are given below :

Initial concentration (mol/L)	Initial rate (mol/L-s)	
	[A]	[B]
(a) 1.0	1.0	2.0×10^{-3}
(b) 2.0	1.0	4.0×10^{-3}
(c) 4.0	1.0	8.0×10^{-3}
(d) 1.0	2.0	2.0×10^{-3}
(e) 1.0	4.0	2.0×10^{-3}

- What are the order of reaction with respect to A and B ?
- What is the overall order ?
- Write the rate law equation.
- Calculate the rate constant
- Suggest a possible mechanism.

ISC Board-2005

- For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained.

t/s	0	10	20
[CH ₃ COOCH ₃]/mol L ⁻¹	0.10	0.05	0.025

- Show that it follows pseudo first order reaction, as the concentration of water remains constant.
- Calculate the average rate of reaction between the time interval 10 to 20 s.
(Given: $\log 2 = 0.3010$, $\log 4 = 0.6021$)

All India 2015

- For a reaction, $A + B \rightarrow P$, the rate is given by Rate = $k [A] [B]^2$

- (a) How is the rate of reaction affected if the concentration of B is doubled?
 (b) What is the overall order of reaction if A is present in large excess?
 (ii) A first order reaction takes 30 min for 50% completion. Calculate the time required for 90% completion of this reaction.
 $(\log 2 = 0.3010)$

All India 2015, Delhi 2015

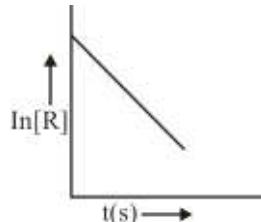
8. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained.

t/s	0	30	60
[CH ₃ COOH] ₃ /mol L ⁻¹	0.60	0.30	0.15

- (i) Show that it follows pseudo first order reaction, as the concentration of water remains constant.
 (ii) Calculate the average rate of reaction between the time interval 30 to 60 s.
 (Given: log 2 = 0.3010, log 4 = 0.6021)

Delhi 2015

9. (i) For a chemical reaction R → P, the variation in the concentration, ln [R] vs time (s) plot is given as



- (a) Predict the order of the reaction.
 (b) What is the slope of curve?
 (c) Write the unit of rate constant for this reaction.
 (ii) Show that the time required for 99% completion is double of the time required for the completion of 90% reaction.

Foreign 2015

10. The data given below is for the reaction,
 $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$

S. No.	N ₂ O ₅ (mol L ⁻¹)	Rate of disappearance of N ₂ O ₅ (mol L ⁻¹ min ⁻¹)
1.	1.13×10^{-2}	34×10^{-5}
2.	0.84×10^{-2}	25×10^{-5}
3.	0.62×10^{-2}	18×10^{-5}

- Determine for this reaction,
 (i) order of reaction (ii) rate law
 (iii) rate constant

All India 2008C

11. Decomposition of H₂O₂ follows a first order reaction. In 50 minutes the concentration of H₂O₂ decreases from 0.5 to 0.125M in one such decomposition. When the concentration of H₂O₂ reaches 0.05M, what is the rate of formation of O₂?

Assam Board-2022

12. Why H₂ and O₂ do not react at room temperature? Write the rate equation for the reaction A₂ + 3B₂ → 2C, if the overall order of the reaction is zero.

Assam Board-2022

13. Write the characteristics of order of reaction.

Tamil Nadu Board-2011

14. Following data are obtained for the reaction : N₂O₅ → 2NO₂ + 1/2O₂

t/s	0	300	600
[N ₂ O ₅]/mol L ⁻¹	1.6×10^{-2}	0.8×10^{-2}	0.4×10^{-2}

- (a) Show that it follows first order reaction.

- (b) Calculate half-life of the reaction.

[Given : log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021]

NIOS Board-2019

15. a) Express instantaneous rate of the following reaction in terms of disappearance of hydrogen N_{2(g)} + 3H_{2(g)} → 2 NH_{3(g)}

- b) For a reaction

X + Y → Z, the rate law is given by

$$\text{rate} = k [X]^{1/2} [Y]^2$$

What is the order of reaction with respect to X and overall order of reaction?

- c) A first order reaction is found to have a rate constant, k = $5.5 \times 10^{-14} \text{ s}^{-1}$. Find the half-life of the reaction.

NIOS Board-2021

16. a) Define the order and molecularity of a reaction.
 b) The half-life of a substance in first-order reaction in 15 minutes. Calculate the rate constant.

NIOS Board-2016

17. a) Write the rate law for a first order reaction. Justify the statement that half life for a first order reaction is independent of the initial concentration of the reactant.
 b) For a first order reaction, show that the time required for 99% completion of the first order reaction is twice the time required for the completion of 90%.

NIOS Board-2022

18. i) Define zero order of reaction. Give one example.
 ii) The first order reaction is 20% complete in 10 minutes. Calculate the time taken for the reaction to go to 80% completion.

NIOS Board-2023

19. i) For the following reaction: C₂H₄ (g) + I₂(g) → C₂H₄I₂(g) the rate equation is-
 $\text{rate} = k [C_2H_4(g)][I_2(g)]^{\frac{3}{2}}$
 (a) What is the order of reaction with respect to each reactant?
 (b) What is the overall order of reaction?

- (ii) Derive the relation $\log \frac{K_1}{K_2} = \frac{-E_a}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$, where K_1 and K_2 are the rate constants at temperature T_1 and T_2 respectively.
- (iii) The half life of a substance in a first reaction is 15 minute. Calculate the rate constant.
- NIOS Board-2023
20. Show that for a first order reaction the time required for 99% completion of a reaction is twice the time required to complete 90% of the reaction.
- Jharkhand Board-2018
21. (A) The rate of a first order reaction, $A \rightarrow B$ is $5.4 \times 10^{-6} \text{ Ms}^{-1}$ when $[A]$ is 0.3M. Calculate the rate constant of the reaction.
(B) Explain the following properties of group 16 elements :
(i) Electronegativity
(ii) Melting and boiling points
(iii) Metallic character
(iv) Allotropy
- Maharashtra board-2019
22. Show that, time required for 99.9 % completion of a first order reaction is three times the time required for 90 % completion. Given electronic configuration of Gd ($Z = 64$). Write the name of nano structured material used in car tyres to increase the life of tyres.
- Maharashtra board-2023
23. For the reaction :
 $C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$
Write.
(i) Differential rate equation
(ii) Rate law equation
(iii) Molecularity
(iv) Order of the reaction.
- Goa Board-2019
24. What is the role of a depressant in froth floatation process?
- Haryana Board-2017
25. The following data were obtained during the first order thermal decomposition of $N_2O_5(g)$ at constant volume—
 $2N_2O_5(g) \rightarrow 2N_2O_4(g) + O_2(g)$
- | S.No. | Time/s | Total Pressure/atm. |
|-------|--------|---------------------|
| 1 | 0 | 0.5 |
| 2 | 100 | 0.512 |
- Calculate the rate constant.
(b) Prove that the time required for 99% completion of a first order reaction is twice the required time for the completion of 90% reaction.
- Uttarakhand Board-2019
26. What do you mean by molecularity of a reaction and order of a reaction?
- Haryana Board-2018
27. The rate constant of a reaction is $3 \times 10^{-3} \text{ min}^{-1}$ at 27°C , at 47°C its value is $9 \times 10^{-3} \text{ min}^{-1}$, then calculate the energy of activation of the reaction. What will be its rate constant at 308°K ?
- Gujarat Board-2019
28. What is meant by pseudo first order reaction? Explain giving example.
- Gujarat Board-2020
29. Starting from the integrated rate law of a zeroth order reaction, $R \rightarrow P$, show that half life time of the reaction is directly proportional to the initial molar concentration of the reactant.
- Assam Board-2018
30. For the reaction $R \rightarrow P$, the rate becomes 4 times faster when the concentration of the reactant R is doubled at a given temperature. What is the order of the reaction?
- Assam Board-2015
31. Write four differences between molecularity and order reaction.
- MP Board-2018
- 32.(a) Half-life period of a reaction increases with increase in initial concentration. Predict the order of the reaction.
(b) Decomposition of a compound follows first-order kinetics. If it takes 15 minutes for 20% of original substance to decay, calculate –
(i) rate constant;
(ii) the time at which 10% of the reactant remains undecayed.
- Meghalaya Board-2019
33. Define activation energy.
- Meghalaya Board-2019
34. The rate of a particular reaction doubles when temperature changes from 27°C to 37°C . Calculate the value of activation energy. ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)
- Meghalaya Board-2019

D. Integrated Rate Equations and Half Life

Section-A : Multiple Choice Questions

1. For a zero order reaction of type $A \rightarrow$ products, the rate equation may be expressed as:
(a) $k = \frac{[A]_0 - [A]}{t}$ (b) $k = \frac{[A] - [A]_0}{t}$
(c) $k = \frac{[A]_0 - [A]}{2t}$ (d) $k = \frac{[A]_0 - [A]}{2}$
- Gujarat Board 2023 (July)
- Ans. (a)
2. The half-life period of a first order reaction is 20 minutes. The time required the concentration of the reactant to change form 0.16 M to 0.02 M is
(a) 80 minutes (b) 60 minutes
(c) 40 minutes (d) 20 minutes
- ISC Board-2017
- Ans. (b)

16. $3\text{ClO}^- \rightarrow \text{ClO}_3^- + 2\text{Cl}^-$
The rate of reaction of above reaction is given by _____.
 (a) $K_1[\text{ClO}^-]^2$ (b) $K_1[\text{Cl}^-]^2$
 (c) $K_1[\text{ClO}_2^-]$ (d) $K_1[\text{ClO}^-]$
- Gujarat Board-2017
- Ans.(a)**
17. For zero order reaction $t_{1/2} \propto$ _____.
 (a) $[R]_0^2$ (b) $[R]_0^{-1}$
 (c) $[R]_0$ (d) $[R]_0^{-2}$
- Gujarat Board-2018
- Ans. (c)**
18. The decomposition of NH_3 on the platinum surface is zero order reaction. If $K=2.5 \times 10^{-4}$ mol/litre second⁻¹, what will be the rate of production of H_2 in mol/litre second⁻¹ unit?
 (a) 2.5×10^{-4}
 (b) 7.5×10^{-4}
 (c) 5.0×10^{-5}
 (d) 0.5×10^{-6}
- Gujarat Board-2019
- Ans. (b)**
- Section-B : Very Short Answer**
1. Write the formula of half-life period for first order reaction.
- UP Board 2023
2. A first order reaction is found to have a rate constant, $k = 6.8 \times 10^{-14} \text{ s}^{-1}$. Find the half life of the reaction.
- Kerala Board 2023
3. Show that half-life period of a first order reaction is independent of initial concentration of the reacting species.
- Karnataka board 2023
4. Derive integrated rate equation for the rate constant of a zero-order reaction.
- Karnataka board 2023
5. (a) Derive the integrated rate equation for the first order reaction,
 (b) A first order reaction has rate constant $2.31 \times 10^{-5} \text{ sec}^{-2}$. Calculate the half-life of the reaction.
- Uttarakhand Board 2023
6. Prove that the time required for 99% completion of a first order reaction is twice the time required for the completion of 90% reaction.
- Uttarakhand Board 2023
7. If half-life period for a first order reaction in A is 2 minutes, how long will it take $[A]_0$ to reach 10% of its initial concentration?
- CBSE-2020
8. A first order reduction takes 30 minutes for 75% decomposition calculate $t_{1/2}$.
Given : $[\log 2 = 0.3, \log 3 = 0.48, \log 4 = 0.6, \log 5 = 0.7]$
- CBSE-2022
9. If half-life period for a first order reaction in A is 2 minutes, how long will it take $[A]_0$ to reach 10% of its initial concentration.
- CBSE-2019
10. For a reaction, $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g})$, rate = $5.5 \times 10^{-14} [\text{C}_2\text{H}_4]$.
 (a) Write the unit of rate constant.
 (b) Calculate its half-life ($t_{1/2}$).
- CBSE-2019
11. Half-life period of a order reaction is on the concentration of the reactant.
- ISC Board-2013
12. The half-life for a first order reaction is 5×10^{-4} s. What percentage of the initial reactant will react in 2 h?
- All India 2009C
13. A first order reaction takes 20 minutes for 25% decomposition. Calculate the time when 75% of the reaction will be completed.
Given : $\log 2 = 0.3010, \log 3 = 0.4771, \log 4 = 0.6021$
- All India 2017
14. Derive the general form of expression for the half-life of first order reaction.
- Delhi 2008; All India 2008
15. Define half-life of a reaction. Write the expression of half-life for
 (i) zero order reaction
 (ii) first order reaction
- Foreign 2014
16. A first order reaction takes 40 min for 30% decomposition. Calculate $t_{1/2}$ for this reaction. (Given, $\log 1.428 = 0.1548$)
- Delhi 2013; All India 2008
17. A first order reaction is found to have a rate constant, $k = 5.5 \times 10^{-14} \text{ s}^{-1}$. Find the half-life of the reaction.
- All India 2013,
18. If half-life period of a first order reaction is x and $3/4^{\text{th}}$ life period of the same reaction is y, how are x and y related to each other?
- Delhi 2013C
19. Define the following terms.
 (i) Half-life of a reaction ($t_{1/2}$)
 (ii) Rate constant (k)
- Delhi 2015C
20. For the gaseous reaction, $a\text{A} + b\text{B} \rightleftharpoons c\text{C} + d\text{D}, \Delta n$ is equal to _____.
Odisha Board-2017
21. What is pseudo first order reaction? Give example.
- Tamil Nadu Board-2011

22. Define half life period of a reaction. Express $t_{\frac{1}{2}}$ in terms of rate constant for first order reaction.

NIOS Board-2019

23. Derive an expression for half -life period of first order reaction.

Karnataka Board-2014

24. A first order reaction is found to have a rate constant, $K = 5.5 \times 10^{-14} \text{ S}^{-1}$. Find the half-life of the reaction.

Karnataka Board-2018

25. The rate constants of a certain first reaction is 200 S^{-1} What is its half life period?

Karnataka Board-2016

26. What happens to the half life period for a first order reaction, if the initial concentration of the reactants is increased.

Karnataka Board-2015

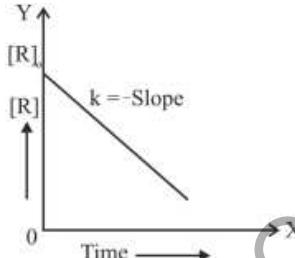
27. Calculate the half-life period of a first order reaction, if the rate constant of the reaction is $6.93 \times 10^{-3} \text{ S}^{-1}$.

Karnataka Board-2015

28. The rate constant of a first order reaction $1.15 \times 10^{-3} \text{ S}^{-1}$. Calculate its half-life period ($t_{\frac{1}{2}}$).

Karnataka Board-2018

29. Examine the graph given below. Identify the integrated rate equation and the order of the reaction corresponding to it.



Kerala Board-2019

30. Prove that half-life period of a zero-order reaction is proportional to initial concentration of a reactant.

Chhattisgarh Board-2021

31. Calculate the rate of the reaction, $A + 2B \rightarrow 2C + D$.

Jharkhand Board-2020

32. For a reaction the unit of rate constant is sec^{-1} . What will be the order of reaction ?

Rajasthan Board-2015

33. Give three examples for first order reaction.

Tamilnadu Board, Sep.-2016

34. Derive the integrated rate equation for first order reaction.

Nagaland Board-2021

35. A first order reaction is found to have a rate constant $k = 5.5 \times 10^{-14} \text{ S}^{-1}$. Find the half life of the reaction.

Nagaland Board-2021

Section-C : Short Answer

1. What is meant by Half-life? Prove that half life period of first order reaction does not depend on its initial concentration.

MP Board 2020

- the half life for radioactive decay of ^{14}C is 6930 years. An archaeological artifact containing wood had only 75% of the ^{14}C found in a living tree. Find the age of the sample.

$$[\log 4 = 0.6021 \log 3 = 0.4771 \log 2 = 0.3010 \log 10 = 1]$$

CBSE-2022

3. In a first order reaction, 10% of the reactant is consumed in 25 min.

Calculate :

- (a) The half-life period of the reaction.
(b) The time required for completing 87.5% of the reaction.

ISC Board-2016

4. If the half-life period of a first order reaction is 69.3 s. What is the value of its rate constant.

ISC Board-2013

5. What is the order of reaction whose rate constant has the same unit as the rate of reaction ?

ISC Board-2016

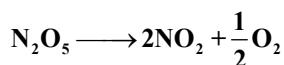
6. The half-life for decay of radioactive ^{14}C is 5730 yr. An archaeological artifact containing wood had only 80% of the ^{14}C found in a living tree. Estimate the age of the sample.

Delhi 2008

All India 2008

Foreign 2008

7. Following data are obtained for the reaction:



t/s	0	300	600
$[\text{N}_2\text{O}_5]/\text{mol L}^{-1}$	1.6×10^{-2}	0.8×10^{-2}	0.4×10^{-2}

Delhi 2017

- (a) Show that it follows first order reaction.

- (b) Calculate the half-life.

(Given: $\log 2 = 0.3010$, $\log 4 = 0.6021$)

Delhi 2017

8. Show that the integrated rate for a first order reaction $\text{R} \rightarrow \text{P}$ is $K = \frac{2.303}{t} \log \frac{[\text{R}]_0}{[\text{R}]}$

Assam Board-2022

9. A first order reaction has a specific reaction rate of $2.31 \times 10^{-3} \text{ sec}^{-1}$. Calculate Half life period of the reaction.

Uttarakhand Board-2020

10. Derive an equation for the rate constant of a first order reaction.

Tamil Nadu Board-2015

11. (a) Explain Kohlrausch's law.
 (b) A first-order reaction is 20% complete in 10 minutes. Calculate the time taken for the reaction to go to 80% completion.
- NIOS Board-2018
12. The rate constant for a first order reaction is $1.54 \times 10^{-3} \text{ sec}^{-1}$. Calculate its half-life period.
- Tamil Nadu Board-2016
13. (a) For a reaction
 $A + B \rightarrow C$
 the rate law is given as
 $\text{rate} = k[A]^2[B]^{1/2}$
 What is the order of this reaction?
 (b) A first-order reaction is found to have a rate constant, $k = 5.5 \times 10^{-14} \text{ s}^{-1}$. Calculate the half-life of the reaction.
- NIOS Board-2014
14. A first order reaction is found to have a rate constant $k = 5.5 \times 10^{-14} \text{ sec}^{-1}$. Find the half life period.
- Punjab Board-2021
15. A first order reaction is 75% completed in 40 minutes, calculate its half life period.
- Punjab Board-2021
16. Derive the equation of rate constant and Half reaction time for first order reaction.
- Gujarat Board-2019
17. a) Derive integrated rate equation for the zero order reaction.
 b) Write the energy distribution curve showing temperature dependence of rate of a reaction.
- Karnataka Board-2016
18. (a) Derive an integrated rate equation for rate constant of a first order reaction.
 (b) The rate constant rate of a reaction is doubled when the temperature increased from 400 K to 410 K. Calculate the activation energy (E_m). [$R=8.314 \text{ JK}^{-1} \text{ mol}^{-1}$]
- Karnataka Board-2019
19. Define half life of first order reaction. Obtain the expression for half life and rate constant of the first order reaction.
- Maharashtra board-2022
20. Prove that half-life period of first-order reaction is independent of the initial concentration of reactant.
- Chhattisgarh Board-2022
21. A first order reaction is 20% completed in 10 minutes. Calculate the time required for 75% completion of the reaction.
- Goa Board-2019
22. (i) Mention any two factors which influence the rate of a chemical reaction.
 (ii) Derive an expression for half life of a first order reaction from its integrated rate equation.
- Kerala Board-2022
23. Define the following terms:
 (a) Half life time
 (b) Order of a reaction
- Haryana Board-2017
24. Write definition of first order reaction.
- Rajasthan Board-2020
25. Differentiate between rate of reaction and specific reaction rate.
- Rajasthan Board-2020
26. Write definition of half life for any chemical reaction.
- Rajasthan Board-2020
27. Show that in a first order reaction, time required for completion of 75% is twice of half life of the reaction. ($\log 2 = 0.3010$)
- Rajasthan Board-2018
28. For reaction $2\text{N}_2\text{O}_5 \rightarrow 2\text{N}_2\text{O}_4 + \text{O}_2$ the Half life time is 6.93 sec, determine the rate constant.
- Rajasthan Board-2017
29. Half life period for first order reaction is 10 sec. Calculate the rate constant for the reaction.
- Rajasthan Board-2015
30. What is half-life of a reaction? Derive formula for finding out half-life from first order rate reaction.
- Rajasthan Board-2013
31. A first order reaction completed 40% in 30 min at 298 K temperature. Same reaction is completed 50% in 10 min at 318 K temperature. What will be the energy of activation of reaction.
- Gujarat Board-2018
32. Calculate half life time of a 1st order reaction having $K = 4 \text{ min}^{-1}$
- Haryana Board-2016
33. A first order reaction has a rate constant of 10^2 s^{-1} . How much time will be taken for 20g of the reactant to be reduced to 5g?
- Assam Board-2019
34. For a reaction $A + B \rightarrow P$, the rate is given by-
 $\text{Rate} = [A][B]^2$
 (i) How is the rate of reaction affected if the concentration of B is doubled?
 (ii) What is the overall order of reaction if A is present in large excess?
- Assam Board-2019
35. Show that in a 1st order reaction, time required for completion of 99.9% is 10 times of half life time of the reaction.
- Assam Board-2018
36. Find out half-life time of a first order reaction with rate constant $k = 2.31 \times 10^{-14} \text{ s}^{-1}$.
- Assam Board-2017
37. A first order reaction takes 40 minutes for 20% decomposition. Calculate its half life period.
- Assam Board-2015
38. Show that the integrated rate law for the first order reaction $R \rightarrow P$ is-
- $$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$
- Assam Board-2015

39. What is rate of reaction? Describe any two factors affecting rate of reaction.
MP Board-2015
40. What is half life period of a reaction? Calculate the half life period of a first order reaction.
MP Board-2015
41. A first order reaction is completed 90% in 40 minutes. Calculate its half-life period. ($\log 10 = 1$)
MP Board-2013
42. What is half life period? Derive its derivation.
MP Board-2012
43. Calculate Half-life period for Ist order reaction.
J & K board-2023
44. Define half-life of a reaction. Show that in a first order reaction, time required for completion of 99.9% is 10 times of half-life ($t_{1/2}$) of the reaction.
Nagaland Board-2020
- 45.(a) When does the average rate of a reaction become equal to instantaneous rate?
(b) Write any one condition under which a bimolecular reaction may be kinetically of first order.
Meghalaya Board-2019
46. For a zero-order reaction, $R \rightarrow P$, derive the integrated rate equation and find its half-life ($t_{1/2}$) time period.
Meghalaya Board-2021
47. The decomposition of NH₃ on platinum surface is a zero order reaction. What are the rates of productions of N₂ and H₂ if $K = 2.5 \times 10^{-4} \text{ mol}^{-1} \text{ L s}^{-1}$.
Assam Board-2023
48. Derive an expression for integrated rate equation for first order reaction.
Nagaland Board-2017
- Section-D : Case Based Study**
1. What is half-life for a chemical reaction ? Show that the half-life for a first order reaction is independent of the initial concentration of the reactants
UP Board 2023
2. The velocity constant for the first order reaction is $6.93 \times 10^{-3} \text{ min}^{-1}$. Calculate the half-life of this reaction.
UP Board 2023
- Section-E : Long Answer**
1. The decomposition of phosphine, PH₃ proceeds according to the following equation:
 $4\text{PH}_3(\text{g}) \longrightarrow \text{P}_4(\text{g}) + 6\text{H}_2(\text{g})$
It is found that the reaction follows the following rate equation
Rate = $k [\text{PH}_3]$
The half-life of PH₃ is 37.9 s at 120°C.
(i) How much time is required for 3/4th of PH₃ to decompose?
- (ii) What fraction of the original sample of PH₃ remains behind after 1 min?
All India 2010; Foreign 2009
2. A first order reaction has a rate constant of 0.0051 min⁻¹. If we begin with 0.10 M concentration of the reactant, what concentration of reactant will remain in solution after 3 hours?
Assam Board-2022
3. (i) What is activation energy ?
Chhattisgarh Board-2023
4. The radioactive ⁹⁰Sr that is formed due to nuclear explosion has half life period of 28.1 years in the body of a child born at this time ⁹⁰Sr is found to be 10^{-6} gram, then what will be ⁹⁰Sr destroyed from the body of child when the age of the child will be 30 years.
Gujarat Board-2016
5. (a) Derive integrated rate equation for rate constant for a first order reaction.
(b) The decomposition of hydrogen peroxide to water and oxygen is a first order reaction with a rate constant of 0.041 min⁻¹. If the initial concentration of hydrogen peroxide is 0.5 M then how long will it take for this concentration to drop to 0.1 M.
[Given : $\log 4 = 0.602$, $\log 5 = 0.699$]
NIOS Board-2022
6. Define half life period of the reaction. Derive integrated rate equation for a first order reaction and find the relation between the rate constant (k) and ($t_{1/2}$) of a first order reaction.
NIOS Board-2023
7. a) Derive an Integrated rate equation for a first order reaction.
b) According to collision theory write two factors responsible for effective collision.
Karnataka Board-2020
8. a) Derive integrated rate equation for a first order reaction.
b) The specific reaction rate of a reaction quadruples when temperature changes from 30°C to 50°C. Calculate the energy of activation of the reaction.
 $T_1 = 30 + 273 = 303\text{K}$
 $T_2 = 50 + 273 = 323\text{K}$
 $T_2 - T_1 = 323 - 303 = 20\text{K}$
Karnataka Board-2019
9. (a) Derive an integrated rate equation for rate constant of first order reaction.
(b) Draw a graph of potential energy V/S reaction co-ordinates showing the effect of catalyst on activation energy (E_a) of a reaction. (Che. Kine)
Karnataka Board-2018
10. (a) Derive an integrate rate equation for rate constant of zero order reaction
(b) Write
(i) Arrhenius equation
(ii) The formula to calculate half life period of zero order reaction.
Karnataka Board-2017

11. (a) Derive the integrated rate equation for the rate constant of a Zero order reaction.
 (b) Draw a graph of potential energy v/s reaction coordinate showing the effect of a catalyst on activation energy.
 Karnataka Board-2016
12. (a) Derive integrated rate equation for the first order reaction.
 (b) According to collision theory, what are the two factors that lead to effective collisions?
 3 + 2
 Karnataka Board-2015
13. (i) Draw the graph of half-life period ($t_{1/2}$) versus initial concentration of reactant ($[A]_0$) for a zero order reaction.
 Give reasons in favour of your answer.
 (ii) The rate of a reaction at 400 K is 10 times than the rate of the reaction at 200 K. Calculate activation energy of the reaction.
 West Bengal Board-2019
14. a) Derive an integrated rate equation for the rate constant of zero order reaction.
 b) Write Arrhenius equation. For what the symbol E_a stands?
 Karnataka Board-2020
15. (a) Derive integrated rate equation for rate constant of zero order reaction.
 (b) Show that the rate of first order reaction is doubled when concentration of the reactant is doubled.
 Karnataka Board-2015
16. (a) Derive an integrated rate equation for rate constant of a first order reaction.
 (b) Draw a graph of potential energy V/S reaction co-ordinates showing the effect of catalyst on activation energy (E_a) of a reaction. (Che. Kine)
 Karnataka Board-2018
17. (a) The half life period of a first order reaction is 6.0 h. Calculate the rate constant
 (b) What are oxides ?
 Write different types of oxides with one example each.
 Maharashtra board-2019
18. The integrated rate equation for a first order reaction is.

$$K = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$
- (i) What is half life period?
 (ii) Derive an expression for the half life period of a first order reaction.
 Kerala Board-2021
19. Show that for a first order reaction, the half life is independent of the initial concentration of reactants.
 Assam Board-2014
20. A first order reaction takes 50 minute for 40% decomposition. Calculate $t_{1/2}$.
 Haryana Board -2016
21. A first order reaction takes 40 min for 30% decomposition. Calculate half life time.
 Haryana Board-2016
22. The rate of reaction is expressed as $-\frac{dC}{dt} = K$
 (i) Obtain an expression for the concentration (C) at time (t) if the initial concentration value is C_0 .
 (ii) Calculate half-life period ($t_{1/2}$) given that the reaction starts with a concentration of 0.1 mol L^{-1} and rate constant $2.5 \times 10^{-4} \text{ mol L}^{-1}\text{S}^{-1}$.
 (iii) Give a qualitative plot of concentration against time.
 Manipur Board-2019
23. For the reaction $A \rightarrow B$, the concentration of a reactant changes from 0.05M to 0.03M in 20 minutes. Calculate the average rate of reaction using units of time both in minutes and seconds.
 Rajasthan Board-2020
24. Calculate the half life of the first order reaction whose rate constant is $5 \times 10^{-14} \text{ s}^{-1}$.
 Rajasthan Board-2016
25. What is pseudo first order reaction? Inversion of cane sugar is which type of reaction. Write it's chemical reaction?
 Rajasthan Board-2016
26. What is half-life period of reaction? Justify from the rate equation for first order reactions that the half-life period for such reaction is independent of the initial concentrations of the reactants.
 Rajasthan Board-2014
27. For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction
 Assam Board-2020
28. The decomposition of N_2O_5 dissolved in carbontetrachloride occurs as follows.

$$\text{N}_2\text{O}_5(\text{solution}) \rightleftharpoons 2\text{NO}_{2(\text{solution})} + \frac{1}{2}\text{O}_{2(\text{g})}$$
- This reaction is of first order and its rate constant is $5.0 \times 10^{-4} \text{ sec}^{-1}$. If initial concentration of N_2O_5 for this reaction is $0.50 \text{ mole litre}^{-1}$, then
 (a) What will be the initial reaction rate?
 (b) What will be half life period of this reaction?
 (c) What will be the concentrations of N_2O_5 and NO_2 at the end of 50 minutes after the starting of reaction?
 Gujarat Board-2018
29. The decomposition of N_2O_5 dissolved in carbon tetra chloride occurs following at constant temperature.

$$\text{N}_2\text{O}_{5(\text{solution})} \rightleftharpoons 2\text{NO}_{2(\text{solution})} + 1/2\text{O}_{2(\text{g})}$$
- This reaction is of first order and its rate constant is $5 \times 10^{-4} \text{ sec}^{-1}$? If initial concentration of N_2O_5 is $0.4 \text{ mol litre}^{-1}$ then.

- (i) What will be the initial reaction rate?
(ii) What will be the half-life period of this reaction?
(iii) What time will be taken to complete 75% reaction?

Gujarat Board-2017

30. Half reaction time for decomposition of H_2O_2 (first order reaction) is 360 min. at 380°C temperature. Energy of activation of reaction is 200 kJ/mole. What will be time required for 75% decomposition at 450°C temperature.

Gujarat Board-2018

31. A first order reaction takes 40 minutes for 30% decomposition. Calculate $t_{1/2}$.

Gujarat Board-2020

32. A reaction is second order with respect to a reactant. How the rate of the reaction be affected if concentration of the reactant is reduced to half?

Assam Board-2016

33. Show that time required for completion 3/4th of a first order reaction is twice the time required for completion of 1/2 of the reaction.

Assam Board-2016

34. What is half-life period of a reaction? Calculate half-life period of a first order reaction.

MP Board-2017

E. Arrhenius Equation

Section-A : Multiple Choice Questions

1. In a plot of $\log k$ vs $1/T$, the slope is
(a) $-E_a/2.303$ (b) $E_a/2.303 R$
(c) $E_a/2.303$ (d) $-E_a/2.303 R$

ISC Board-2012

- Ans. (d)
2. For a reaction $E_a = 0$ and $k = 4.2 \times 10^5 \text{ sec}^{-1}$ at 300 K , the value of K at 310 K will be
(a) $4.2 \times 10^5 \text{ sec}^{-1}$
(b) $8.4 \times 10^5 \text{ sec}^{-1}$
(c) $8.4 \times 10^5 \text{ sec}$
(d) unpredictable

Tamil Nadu Board-2011

- Ans. (b)
3. During decomposition of an activated complex:
(a) Energy is always released
(b) Energy is always absorbed
(c) Energy does not change
(d) None of the above

Haryana Board-2017

- Ans. (a)
4. Arrhenius equation is represented by:
(a) $K = Ae^{E_a/RT}$ (b) $K = Ae^{-E_a/RT}$
(c) $t_{1/2} = 0.693/K$ (d) None of the above

Haryana Board-2017

- Ans. (b)

5. For a reaction, the of slope of a plot in $\ln K \rightarrow \frac{1}{T} = \dots$.

- (a) $-E_a$ (b) $-\frac{E_a}{2.303}$
(c) $-\frac{E_a}{R}$ (d) $-\frac{E_a}{2.303R}$

Gujarat Board-2018

Ans. (c) :

6. What is the value of slope in the graph of $\log_{10} K$ against $\frac{1}{T}$?

- (a) $-\frac{E_a}{R}$ (b) $-\frac{E_a}{2.303R}$
(c) $-\frac{K}{2.303}$ (d) $-K$

Gujarat Board-2019

Ans. (b)

7. The rate constant of a reaction at 500 K is 0.02 S^{-1} . Its Activation Energy (E_a) is 18.230 KJ . Calculate Arrhenius constant?

- (a) 1.2 (b) 1.4
(c) 1.3 (d) 1.6

Gujarat Board-2020

Ans. (d)

Section-B : Very Short Answer

1. Write Arrhenius equation.

ISC Board-2005

2. Correct the following statement. The rate constant of a reaction increases linearly with increase in temperature.

ISC Board-2003

3. Arrhenius equation is related to.....

ISC Board-2002

4. Activation energy can be determined by.....

ISC Board-2013

5. The rate of most reaction become double when their temperature is raised from 298 K to 308 K . Calculate their activation energy.
(Given, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$)

Delhi 2011C

6. The rate of a reaction becomes four times when the temperature changes from 300 K to 320 K . Calculate the energy of activation of the reaction, assuming that it does not change with temperature.
 $(R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1})$

All India 2010; Foreign 2008

7. Define activation energy.

All India 2012, 2011, 2010, 2009

1. Define the following terms.

- (i) Rate constant (k)
(ii) Activation energy (E_a)

Delhi 2014C

2. Define each of the following.
 (i) Specific rate of a reaction
 (ii) Energy of activation of a reaction
- All India 2014C
3. What is the effect of adding a catalyst on
 (a) Activation energy (E_a) and
 (b) Gibbs energy (ΔG) of a reaction?
- All India 2017
4. For a chemical reaction, what is the effect of a catalyst on the following?
 (i) Activation energy of the reaction.
 (ii) Rate constant of the reaction.
- All India 2008C
5. If the activation energy of a reaction is low, the reaction is relatively _____.
- Odisha Board-2017
6. Define activation energy.
- Tamil Nadu Board-2015
7. A first order reaction is 50% completed in 40 minutes at 300 K and in 20 minutes at 320 K. Calculate the activation energy of the reaction. (Given : $\log 2 = 0.3010$, $\log 4 = 0.6021$, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)
- UP Board-2018
8. A catalyst the activation Energy.
- Haryana Board-2022
9. In the equation $K = Ae^{-E_a/RT}$, E_a is
- Haryana Board-2022
10. What are nucleic acids? Mention their two important functions?
- Jharkhand Board-2020
11. A key reaction in the upper atmosphere is $O_3 \text{ (g)} + O \text{ (g)} \rightarrow 2O_2 \text{ (g)}$. The E_a for the forward reaction is 19 kJ, and the ΔH_{rxn} is -392 kJ. What will be the E_a for the reverse reaction?
- Manipur Board-2022
2. Fill in the blanks :
 1. Arrhenius equation is represented by _____.
- MP Board-2018
2. Write Arrhenius equation.
- MP Board-2015
3. Arrhenius equation is represented by
- MP Board-2012
- Section-C : Short Answer**
1. (a) The decomposition of a hydrocarbon has value of rate constant as $2.5 \times 10^4 \text{ s}^{-1}$ at 27°C . At what temperature would rate constant be $7.5 \times 10^4 \text{ s}^{-1}$ if energy of activation is $19.147 \times 10^3 \text{ J mol}^{-1}$?
 (b) Write a condition under which a bimolecular reaction is kinetically first order. Give an example of such a reaction. (Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 5 = 0.6990$)
- CBSE-2019
2. Draw a graph which is used to calculate the activation energy of a reaction. Give the appropriate expressions used to calculate the activation energy graphically.
- ISC Board-2006
3. The rate constant for the first order decomposition of H_2O_2 is given by the following equation:
- $$\log k = 14.2 - \frac{1.0 \times 10^4}{T}$$
- Calculate E_a for this reaction and rate constant k if its half-life period be 200 min. (Given: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)
- Delhi 2016
4. The rate constants of a reaction at 500 K and 700 K are 0.02 s^{-1} and 0.07 s^{-1} respectively. Calculate the value of activation energy, E_a . ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$).
- Delhi 2015C
5. For a decomposition reaction, the values of k at two different temperatures are given below.
 $k_1 = 2.15 \times 10^{-8} \text{ L/mol.s}$ at 650 K
 $k_2 = 2.39 \times 10^{-7} \text{ L/mol.s}$ at 700 K
 Calculate the value of E_a for the reaction. (Given, $\log 11.11 = 1.046$
 $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)
- All India 2014, 2009
 Foreign 2009
6. The decomposition of A into products has a value of k as $4.5 \times 10^3 \text{ s}^{-1}$ at 10°C and energy of activation 60 kJ mol^{-1} . At what temperature would k be $1.5 \times 10^4 \text{ s}^{-1}$?
- Delhi 2013C
7. Rate constant 'k' of a reaction varies with temperature 'T' according to the equation

$$\log k = \log A - \frac{E_a}{2.303R} \left(\frac{1}{T} \right)$$
 where E_a is the activation energy. When a graph is plotted for $\log k$ vs $\frac{1}{T}$, a straight line with a slope of -4250 K is obtained. Calculate ' E_a ' for the reaction. ($R = 8.314 \text{ K}^{-1} \text{ mol}^{-1}$)
- Delhi 2013
8. The rate of a reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of the activation (E_a) of the reaction assuming that it does not change with temperature.
 $(R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}, \log 4 = 0.6021)$
- Delhi 2010
9. The activation energy for the reaction $2HI \text{ (g)} \rightarrow H_2 \text{ (g)} + I_2 \text{ (g)}$ is $209.5 \text{ kJ mol}^{-1}$ at 581 K . Calculate the fraction of molecules having energy equal to or greater than activation energy.
 $(R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1})$
- HOTS; All India 2010

10. The decomposition of phosphine,
 $4\text{PH}_3(\text{g}) \rightarrow \text{P}_4(\text{g}) + 6\text{H}_2(\text{g})$
has the rate law, rate = $k [\text{PH}_3]$
The rate constant is $6.0 \times 10^{-4} \text{ s}^{-1}$ at 300 K and activation energy is $3.05 \times 10^5 \text{ J mol}^{-1}$. Calculate the value of rate constant at 310 K.
(Given, R = $8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)
HOTS; Delhi 2008C
11. What is Arrhenius equation and explain the terms.
Tamil Nadu Board-2015
12. What are active centers?
Tamil Nadu Board-2015
13. Write the Arrhenius equation and explain the terms.
Tamil Nadu Board-2011
14. The slope the line in the graph of $\log k$ versus $\frac{1}{T}$ for a reaction is 5841 K. Calculate activation energy (E_a) for the reaction.
NIOS Board-2018
15. Give the evidence in favour of Arrhenius theory of electrolytic dissociation.
Tamil Nadu Board-2018
16. (a) The rate constants of a reaction at 500 K and 700 K are 0.02 S^{-1} and 0.07 S^{-1} respectively. Calculate the value of E_a .
(b) Under what condition a bimolecular reaction behaves kinetically first order reaction ?
Haryana Board-2019
17. Calculate the activation energy of a reaction whose rate constants are $1.2 \times 10^{-3} \text{ s}^{-1}$ and $2.4 \times 10^{-3} \text{ s}^{-1}$ at 30°C and 40°C respectively. [R = $8.314 \text{ JK}^{-1} \text{ mol}^{-1}$]
Goa Board-2018
18. What is Arhenius equation? What is its importance?
J&K Board-2019
19. Write Arrhenius equation. Derive an expression for temperature variations.
Maharashtra board-2019
20. The rate constant of a reaction at 293 K is $1.7 \times 10^5 \text{ s}^{-1}$. When the temperature is increased by 20 K, the rate constant is increased to $2.57 \times 10^6 \text{ s}^{-1}$. Calculate E_a and A of the reaction.
Kerala Board-2019
21. (i) Write Arrhenius equation.
(ii) How will you obtain the value of activation energy (E_a) from a graphical plot using Arrhenius equation?
Kerala Board-2022
22. Define the terms:
(i) Activation Energy
(ii) Molecularity
(iii) Rate constant
Haryana Board-2017
23. Explain the importance of Activation Energy.
Haryana Board-2018
24. Draw a diagram showing effect of catalyst on activation energy.
Rajasthan Board-2016
25. Write short notes on:
(i) Threshold Energy
(ii) Energy of Activation
MP Board-2016
26. What do you understand by order of reaction? Give three examples of first order of reactions.
MP Board-2016
27. Write short notes on:
(i) Activation energy
(ii) Arrhenius equation.
MP Board-2013
28. Define Activation Energy. How is it related to threshold energy?
J & K Board-2021

Section-E : Long Answer

1. (i) Write the mathematical expression relating the variation of rate constant of a reaction with temperature.
(ii) How can you graphically find the activation energy of the reaction from the above expression ?
(iii) The slope of the line in the graph of $\log k$ ($k = \text{rate constant}$) versus $\frac{1}{T}$ is -5841.
Calculate the activation energy of the reaction.
ISC Board-2014
2. (i) Define the following terms.
(a) Activation energy
(b) Rate constant
(ii) A first order reaction takes 10 min for 25% decomposition. Calculate $t_{1/2}$ for the reaction.
(Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$)
Foreign 2015
3. Write Arrhenius equation and explain the terms.
Tamil Nadu Board-2011
4. (a) What is activation energy of a reaction?
(b) The rate of reaction increases in presence of catalyst. Explain the statement by plotting a curve between reaction coordinate and energy.
(c) For a reaction, the initial concentration of reactant is 0.4M and rate constant is $2.5 \times 10^{-4} \text{ mol L}^{-1}\text{s}^{-1}$. Calculate the half - life period of the reaction.
Manipur Board-2017
5. a) The rate of reaction increases by 2 times when the temperature of the reaction raised from 300K to 310K. Calculate the energy of activation of the reaction. (Give R = 8.314JK/mole).
b) Write any two differences between molecularity and order of reaction.
Karnataka Board-2014

6. (a) The rate of a particular reaction doubles when the temperature changes from 300K to 310K. Calculate the energy of activation of the reaction.
[Given: $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$].

(b) Show that the half-life period of a first order reaction is independent of initial concentration of reacting species.

Karnataka Board-2014

7. (i) Write Arrhenius equation.
(ii) The rate of a reaction doubles when the temperature is increased from 298K to 308K. Calculate the activation energy.
(iii) Give two differences between order and molecularity.

Kerala Board-2021

8. The temperature dependence of the rate of a chemical reaction can be explained by Arrhenius equation.
(a) Give Arrhenius equation
(b) The rate of a chemical reaction doubles for an increase of 10 K in absolute temperature from 300 K. Calculate the activation energy (E_a)?
 $[R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}, \log 2 = 0.3010]$

Kerala Board-2020

9. Plot a graph between $\ln K$ and $1/T$ on the basis of Arrhenius equation.

F. Factor Affecting Rate of Reactions

Section-A : Multiple Choice Questions

- 1. Which one is the correct factor that explains the increase of rate of reaction by a catalyst?**

 - (a) Shape selectivity
 - (b) Particle size
 - (c) Increase of free energy
 - (d) Lowering of activation energy

Tamil Nadu Board-2016

Ans. (d)

- 2. The rate of chemical reaction depends upon—**

 - (a) Active mass
 - (b) Atomic mass
 - (c) Equivalent weight
 - (d) Molecular mass

MP Board-2017

Ans. (a)

3. A reaction is first order in A and second order in B. How is the rate affected when concentrations of both A and B are doubled?

 - (a) It increases 4 times
 - (b) It increases 6 times
 - (c) It increases 8 times
 - (d) It reduces 8 times

Jharkhand Board-2023

Ans. (c)

Section-B : Very Short Answer

1. Explain with a suitable example the process of vapour phase refining **Manipur Board 2023**

2. What is the effect of temperature on the rate constant of a reaction? How can this temperature effect on rate constant be expressed quantitatively? **Delhi 2010C**
All India 2009C

3. How does a change in temperature affect the rate of a reaction? How can this effect on the rate constant of a reaction be represented quantitatively? **All India 2014C**

4. Mention any two factors which influence the rate of the reaction. **Karnataka Board-2020**

5. A reaction is first order with respect to reactant A and second order with respect to reactant B in a reaction
 $A + B \rightarrow \text{product}$.
(i) Write the differential rate equation
(ii) How is the rate of the reaction affected on increasing the concentration of B by two times? **Karnataka Board-2015**

6. Name any two factors affecting the rate of a reaction. **Karnataka Board-2019**

7. Which bond links amino acids together. **MP Board-2017**

8. What is instantaneous rate of reaction ? **Nagaland Board-2018**

Section-C : Short Answer

1. How will the rate of the reaction be affected when
(a) Surface area of the reactant is reduced,
(b) Catalyst is added in a reversible reaction, and
(c) Temperature of the reaction is increased? **CBSE-2020**

2. List any two factors that influence the rate of chemical reaction. Indicate whether the rate constant of the reaction is dependent or independent on these factors. **ISC Board-2002**

3. Show graphically the average and instantaneous rate of a reaction. **Haryana Board -2016**

4. What are the factors which effect the rate of a chemical reaction? **Rajasthan Board-2016**

5. Write the names of four factors affecting the rate of reaction. **Rajasthan Board-2011**

6. What will be the effect of temperature on rate of reaction? **Haryana Board-2016**

7. The rate of a particular reaction doubles when temperature changes from 27°C to 37°C . Calculate the energy of activation of such a reaction. (Given $\log 2 = 0.30$) **Jharkhand Board-2023**

Section-E : Long Answer

- What is catalysis? How is catalysis classified? Gave one example for each of catalysis.
Andhra Pradesh Board-2020
- Describe the effect of nature of reactants and concentration of reactants on rate of reaction.
Haryana Board-2016
- The rate constant of a reaction at 300 K is $5.0 \times 10^{-4} \text{ minute}^{-1}$. The temperature was increased by 20 K and the value of rate constant 'K' increased three times. Calculate the energy of activation of the reaction? What will be the value of rate constant at 37°C? [$R = 1.987 \text{ calori. Kelvin}^{-1}. \text{ mol}^{-1}$]
Gujarat Board-2018
- Show that slope of the plot of $\ln k$ against $\frac{1}{T}$ is $-\frac{E_a}{R}$. Give the graphical representation of the plot.
Assam Board-2017
- Describe four factors affecting rate of a reaction.
MP Board-2017

G. Collision Theory of Chemical Reactions

Section-A : Multiple Choice Questions

- The number of molecules that react with each other in an elementary reaction is a measure of the:
 - activation energy of the reaction
 - order of the reaction
 - stoichiometry of the reaction
 - molecularity of the reaction
- Gujarat Board 2023 (July)

Ans. (d)

Section-B : Very Short Answer

- What is effective collision? Write any two factors responsible for effective collision.
Karnataka board 2023
- Write Collision Theory of Chemical Reactions.
Uttarakhand Board 2023
- With the help of diagram, explain the role of activated complex in a reaction.
Delhi 2013C
- In some cases, it is found that a large number of colliding molecules have energy more than threshold energy, yet the reaction is slow. Why?
Delhi 2013C
- Give the definition of collision frequency.
Assam Board-2016
- What is the name of reactions which are initiated by the radiations.
MP Board-2016

Section-C : Short Answer

- A solution containing 1.9 g per 100 mL of KCl ($M = 74.5 \text{ g mol}^{-1}$) is isotonic with a solution containing 3 g per 100 mL of urea ($M = 60 \text{ g mol}^{-1}$). Calculate the degree of dissociation of KCl solution. Assume that both the solutions have same temperature.

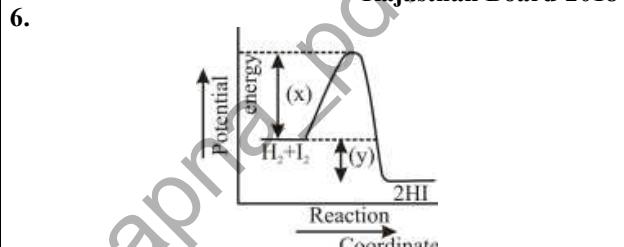
CBSE-2019

- Write notes on the following
 (a) Electrophoresis (diagram is not required)
 (b) Macromolecular colloid
Chhattisgarh Board-2022

- Define collision frequency.
Assam Board-2014

- Define the following:
 (a) Collision frequency
 (b) Half life period
Haryana Board-2016

- According to collision theory, write two main barriers for any chemical reaction.
Rajasthan Board-2018



- (a) Write suitable name of (X) and (Y) denoted in above graph.
 (b) Give definition of only (A) denoted in graph.
Rajasthan Board-2017
- Define activation energy of a reaction.
Assam Board-2015

Section-E : Long Answer

- Give a detailed account of the collision theory of reaction rates of bimolecular gaseous reactions.
Telangana Board-2017
- Describe the salient features of the collision theory of reaction rates.
Telangana Board-2023
- a) Derive integrated rate equation for the first order reaction.
 b) According to collision theory, what are the two factors that lead to effective collisions?
Karnataka Board-2017
- a) Derive the integrated rate equation of Zero Order Reaction.
 b) Write Collision theory of Chemical Reaction.
Uttarakhand Board-2019
- What is the difference between activation energy and threshold energy? Indicate activation energy and threshold energy in reaction energy diagram. Why is transition state theory better than collision theory?
Rajasthan Board-2010
- The rate constant of a reaction at 500 K and 700 K are 0.02 s^{-1} and 0.07 s^{-1} respectively. Calculate the value of activation energy for the reaction. ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$).
Assam Board-2013

A. Homogenous and Heterogeneous Catalysis
Section-A : Multiple Choice Questions

1. At equilibrium state in process of adsorption
 (a) $\Delta H < T \Delta S$ (b) $\Delta H > T \Delta S$
 (c) $\Delta H > 0$ (d) $\Delta H = T \Delta S$

Gujarat Board 2023 (March)

Ans. (d)

2. What is the slope of the graph $\log \frac{x}{m} \rightarrow \log P$.
 (a) $\frac{1}{n}$ (b) n
 (c) $\frac{x}{m}$ (d) K

Gujarat Board 2022 (July)

Ans. (a)

3. The decomposition of hydrogen peroxide in the presence of colloidal platinum is a/an
 (a) positive catalysis
 (b) negative catalysis
 (c) auto catalysis
 (d) induced catalysis

Tamil Nadu Board-2011

Ans. (a)

4. _____ is the catalyst in the oxidation of oxalic acid with acidified $KMnO_4$.
 (a) $KMnO_4$ (b) $(COOH)_2$
 (c) $MnSO_4$ (d) K_2SO_4

Tamil Nadu Board, Sep.-2016

Ans. (c)

Section-B : Very Short Answer

1. (b) Write three differences between Physisorption and Chemisorption. CBSE-2022
2. Give one example each of homogeneous and heterogeneous catalysis. ISC Board-2006
3. Give an example (equation) of a homogeneously catalysed reaction and name the catalyst ISC Board-2012
4. What are lyophilic and lyophobic colloids? Which of these sols can be easily coagulated on the addition of small amount of electrolytes and why? Delhi 2013, 2008; Foreign 2008

5. What are lyophobic colloids? Give one example for them.

All India 2011

6. What is the difference between lyophobic sol and lyophilic sol?

Delhi 2014C

7. Give one example each of lyophobic sol and lyophilic sol.

All India 2014

8. Distinguish between homogeneous and heterogeneous catalysis. What role does adsorption play in heterogeneous catalysis?

All India 2008C

9. Give reason. Zeolites are good shape-selective catalyst.

Karnataka Board-2020

10. Give one point of distinction between the following:

- (a) Homogeneous catalysis and heterogeneous catalysis

- (b) Physisorption and chemisorption.

Goa Board-2019

11. Who used the word 'catalyst' for the first time?

MP Board-2013

12. Fill in the blanks:

- (e) Catalysts which increase rate of a reaction are called catalyst.

MP Board-2013

Section-C : Short Answer

1. Define Lyophobic and Lyophilic sol with a suitable example of each. Why is coagulation of Lyophilic sol difficult as compared to Lyophobic sol ?

CBSE-2020

2. Distinguish between physisorption and chemisorption on the basis of

- (a) Force of attraction,

- (b) Temperature, and

- (c) Enthalpy of adsorption.

CBSE-2020

3. Give three points of difference between physisorption and chemisorptions.

CBSE-2020

4. Give reasons for the following observations:

- (i) Leather gets hardened after tanning.

- (ii) Lyophilic sol is more stable than lyophobic sol.

- (iii) It is necessary to remove CO when ammonia is prepared by Haber's process.

Delhi 2015

5. Write one difference in each of the following:

- (i) Lyophobic sol and lyophilic sol.
- (ii) Solution and colloid.
- (iii) Homogeneous catalysis and heterogeneous catalysis.

Delhi 2017

6. Explain how the phenomenon of adsorption finds application in the following processes?

- (i) Production of high vacuum
- (ii) Heterogeneous catalysis

All India 2013

7. Give one point of distinction between the following:

- (a) Homogeneous catalysis and heterogeneous catalysis
- (b) Physisorption and chemisorption.

Goa Board-2023

8. Differentiate simple and complex reactions.

Tamil Nadu Board-2016

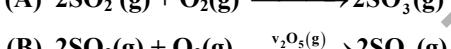
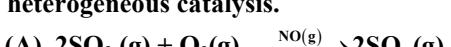
9. a) How is Gold-sol prepared by Bredig's -arc method?

- b) What is Homogeneous catalysis? Give an example.

- c) How does entropy change (ΔS) for adsorption?

Karnataka Board-2019

10. Classify following as homogeneous and heterogeneous catalysis.



Kerala Board-2021

11. (i) Distinguish homogeneous and heterogeneous catalysis.

- (ii) Explain Tyndall effect. Write any one practical application of this effect.

Kerala Board-2022

12. What is selectivity of catalyst? Write example.

Rajasthan Board-2015

13. What are the differences between simple and complex reactions?

Tamilnadu Board, Sep.-2016

14. Give the difference between physisorption and chemisorptions.

Nagaland Board-2020

15. (a) Indicate a chemical reaction involving homogeneous catalyst.

- (b) What is Brownian movement?

- (c) Comment on the following statement : Colloid is not a substance but a state of substance.

Meghalaya Board-2018

Section-E : Long Answer

1. Explain clearly how the phenomenon of adsorption finds application in

- (i) production of vacuum in a vessel.

- (ii) heterogeneous catalysis.

- (iii) froth floatation process in metallurgy.

All India 2014C, Delhi 2011

2. a) Write a note on Dialysis.

- b) What is the effect on ΔH and ΔS during the process of adsorption?

- c) Give an example for heterogeneous catalysis.

Karnataka Board-2020

3. a) Define shape selective catalysis. Name the Zeolite Catalyst used to convert alcohols to gasoline in petroleum industry.

- b) What is Peptisation? Give an Example.

- c) Write the expression for Freundlich adsorption isotherm.

Karnataka Board-2019

4. Consider the following reaction :



- (a) Is this reaction :

- (i) homogeneous or heterogeneous and

- (ii) exothermic or endothermic ?

- (b) Write expression for K_p and K_c for this reaction.

- (c) What are the favourable conditions for obtaining maximum yield of NH_3 using this reaction ?

NIOS Board-2015

5. a) What is shape selective catalysis? Give an example of such type of catalyst.

- b) What are emulsions? Give an example of oil dispersed in water (o/w) type emulsion.

- c) Mention any one application of adsorption.

Karnataka Board-2017

6. a) Write any two characteristics of chemical adsorption. 2

- b) What is Brownian movement? What is the cause for it? 2

- c) What is homogeneous catalyst. 1

Karnataka Board-2018

7. Define homogeneous and heterogeneous catalysis. Give an example of each.

Rajasthan Board-2013

B. Adsorption

Section-A : Multiple Choice Questions

1. Freundlich adsorption isotherm is given by expression :

$$(a) \frac{x}{m} K \quad (b) \frac{x}{m} KP^n$$

$$(c) \frac{x}{m} KP^{\frac{1}{n}} \quad (d) \frac{x}{m} P$$

Gujarat Board-2021

Ans. (c)

2. In the reversible reaction $2\text{HI} \rightleftharpoons \text{H}_2 + \text{I}_2$, K_p is :
- Greater than K_c
 - Less than K_c
 - Equal to K_c
 - Zero

Tamil Nadu Board-2015

Ans. (c)

3. For chemisorptions which is wrong?
- It is irreversible
 - It requires activation energy
 - It forms multilayers on adsorbate
 - Surface compounds are formed.

Tamil Nadu Board-2011, 2018

Ans. (c)

4. In case of physical adsorption, there is desorption when
- temperature increases
 - temperature decreases
 - pressure increases
 - concentration increases

Tamil Nadu Board-2011

Ans. (a)

5. Adsorption is:
- Surface phenomenon
 - Colligative property
 - Oxidation process
 - Reduction process

Haryana Board-2022

Ans. (a)

6. Which of the following is not a favourable condition for physical adsorption?
- High pressure
 - $-\Delta H$
 - High temperature
 - None of the above

Haryana Board-2017

Ans. (c)

7. Which is not natural polymer among the following?
- Starch
 - Wool
 - Silk
 - Nylon

Rajasthan Board-2010

Ans. (d)

8. The magnitude of gaseous adsorption does not depend upon:
- temperature
 - pressure
 - nature of the gas
 - amount of the adsorbent

Tamilnadu Board, Sep.-2016

Ans. (b)

9. Which will be the equation for Langmuir adsorption isotherm at low pressure.

- $\frac{x}{m} = \frac{a}{a+p}$
- $\frac{x}{m} = ap$
- $\frac{x}{m} = \frac{1}{n}p$
- $\frac{x}{m} = \frac{b}{a}$

Gujarat Board-2016

Ans.(b)

10. Which equation of Langmuir adsorption isotherm will apply at high pressure?

$$(a) \frac{x}{m} = \frac{1}{a+p}$$

$$(b) \frac{x}{m} = a \cdot p$$

$$(c) \frac{x}{m} = \frac{b}{a}$$

$$(d) \frac{x}{m} = \frac{a}{b}$$

Gujarat Board-2018

Ans.(d) :

11. Which equation is true for Langmuir adsorption isotherm at low pressure?

$$(a) \frac{x}{m} = \frac{b}{a}$$

$$(b) \frac{x}{m} = ap$$

$$(c) \frac{x}{m} = \frac{1}{n} \times p$$

$$(d) \frac{x}{m} = \frac{a}{b}$$

Gujarat Board-2019

Ans. (b)

Section-B : Very Short Answer

1. Why does physisorption decrease with rise of temperature?

Manipur Board 2020

2. Write the expression of Freundlich adsorption isotherm. In this isotherm, what is the value of "1/n" to show that adsorption is independent of pressure.

Karnataka board 2023

3. The accumulation of molecular species at the surface rather than in the bulk of a solid or liquid is termed _____.

Rajasthan Board 2023

4. Define adsorption with an example. What is the role of adsorption in heterogeneous catalysis ?

CBSE-2020

5. Define adsorption isotherm. Give the empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.

CBSE-2020

6. An organic compound is adsorbed on the surface of silica gel. process of removing the organic compound from silica gel.

CBSE-2020

7. (i) Write the Freundlich adsorption isotherm at (I) low pressure, and (II) high pressure.

- (ii) Why is adsorption exothermic in nature? What is the effect of increasing temperature on adsorption?

CBSE-2022

8. Write any three differences between physisorption and chemisorptions.

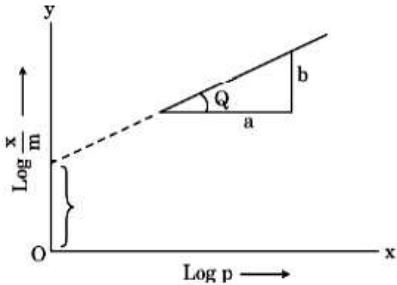
CBSE-2022

9. The conductivity of 0.001 mol L^{-1} solution of acetic acid is $3.905 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity. If Λ_m° for acetic acid is $390.5 \text{ S cm}^2 \text{ mol}^{-1}$, then calculate its degree of dissociation (α).

CBSE-2022

10. Write three differences between Physisorption and Chemisorption.
CBSE-2022
11. Write three differences between physisorption and chemisorption.
CBSE-2019
12. Why is desorption important for a substance to act as a catalyst?
CBSE-2019
13. Adsorption of a gas on surface of solid is generally accompanied by a decrease in entropy, still it is a spontaneous process. Explain.
Delhi 2012C
14. Write the two applications of adsorption.
All India 2012C
15. Physisorption is multilayered, while chemisorptions is monolayered.
Delhi 2012C
16. What is meant by chemisorption?
Delhi 2011C
17. Why is a finely divided substance more effective as an adsorbent?
All India 2011; Delhi 2010C
18. Define the term of desorption.
Delhi 2011
19. Name two types of adsorption phenomena.
Delhi 2010, 2009C
20. What is the sign of ΔH and ΔS when a gas is adsorbed by an adsorbent?
Delhi 2010, 2009C
21. What is the basic difference between adsorption and absorption?
All India 2010C
22. What are physisorption and chemisorptions.
All India 2010C
23. Distinguish between physisorption and chemisorption.
All India 2010C
24. Why does physisorption decrease with the increase of temperature?
HOTS; Delhi 2008C
25. In chemisorption, why x/m initially increases and then decreases with rise in temperature?
HOTS; Delhi 2008C
26. Write one similarity between physisorption and chemisorption.
Delhi 2017
27. Physisorption is reversible while chemisorption is irreversible. Why?
Foreign 2015
28. Define the following term by giving an example; Adsorption.
Delhi 2015C, 2014C
All India 2013
29. What is the effect of temperature on chemisorptions?
Delhi 2014
30. What type of forces are responsible for the occurrence of physisorption?
Foreign 2014
31. Why is adsorption always exothermic?
Delhi 2014, All India 2010, 2009C
32. Out of physisorption or chemisorption, which has a higher enthalpy of adsorption?
All India 2013, 2008; Delhi 2008
33. Write three differences between physical and chemical adsorption.
Odisha Board-2020
34. Physical and chemical adsorptions respond differently to a rise in temperature. What is the difference and why is it so?
Manipur Board-2018
35. How do the size of the particles of adsorbent and pressure of the gas influence the extent of adsorption?
Manipur Board-2017
36. Among physisorption chemisorptions which one has higher enthalpy of adsorption?
Karnataka Board-2019
37. Out of physisorption of chemisorptions which one has lower enthalpy of adsorption?
Karnataka Board-2016
38. (a) Give two differences between Physical adsorption and Chemical adsorption.
(b) What is Emulsion ? Name the types of Emulsions.
Punjab Board-2019
- 39.(i) The accumulation of molecular species at the surface rather than in the bulk of a solid or liquid is termed adsorption.
(a) What is adsorption isotherm?
(b) Write the mathematical expression of Freundlich adsorption isotherm.
(ii) Enzymes are known as biochemical catalysts. Write any two important characteristics of enzyme catalysis.
Kerala Board-2013
40. What happens to the entropy of a gas after adsorption?
Karnataka Board-2017
41. Enthalpy of physical adsorption is quite low. Give reason.
Karnataka Board-2019
42. What is called physical adsorption ?
Chhattisgarh Board-2022
43. Write any three differences between physical and chemical adsorption.
Chhattisgarh Board-2021
44. What is adsorption ? Give any three differences between physical adsorption and chemical adsorption.
Andhra Pradesh Board-2021
45. Due to which forces physisorption arises ?
Rajasthan Board-2016
46. The curve showing the variation of adsorption with pressure at constant temperature is called _____.
Assam Board-2019
47. The curve showing the variation of adsorption with pressure at constant temperature is called _____.
Assam Board-2016
48. Which has a higher enthalpy of adsorption physisorption or chemisorption?
Assam Board-2012

Section-C : Short Answer

1. Write four main differences in physical adsorption and chemisorptions. UP Board 2019
2. (a) Compound physisorption and chemisorptions on the basis of
 (i) Specificity and
 (ii) enthalpy of adsorption
 (b) Differentiate between adsorption and absorption CBSE-2020
3. Give reasons:
 (a) Adsorption of gas on the surface of a solid is generally accompanied by decrease in entropy, still it is a spontaneous process.
 (b) A delta is formed at the meeting point of sea water and river water.
 (c) Digestion gets affected during fever. CBSE-2020
4. Observe the given figure and answer the following questions :

- (i) Write the expression for adsorption of gases on solids in the form of an equation.
 (ii) What is the slope of the graph ?
 (iii) What does the intercept of the line represent ? CBSE-2022
5. (a) Differentiate between the following:
 (i) Adsorption and Absorption
 (ii) Lyophobic Sol and Lyophilic Sol
 (iii) Multimolecular Colloid and Macromolecular colloid. CBSE-2022
6. Define the following terms :
 (d) Adsorption
 (d) Lyophobic sol
 (d) Multimolecular colloid CBSE-2022
7. (a) Write the dispersed phase and dispersion medium of milk.
 (b) Why is adsorption exothermic in nature ?
 (c) Write Freundlich adsorption isotherm for gases at high pressure. CBSE-2019
8. Give reasons for the following:
 (a) Leather gets hardened after tanning.
 (b) FeCl_3 is preferred over KCl in case of a cut leading to bleeding.
9. (c) Freundlich isotherm becomes independent of pressure at high pressure for a gas absorbed on a solid. CBSE-2019
10. (i) Write the expression for the Freundlich's adsorption isotherm for the adsorption of gases on solids, in the form of an equation.
 (ii) What are the dispersed phase and dispersion medium of butter?
 (iii) A delta is formed at the meeting place of sea and river water. Why? All India 2013
11. (i) In reference to Freundlich's adsorption isotherm, write the expression for adsorption of gases on solids in the form of an equation.
 (ii) Write an important characteristic of lyophilic sols.
 (iii) Based on the type of particles of dispersed phase, give one example each of associated colloid and multimolecular colloid. All India 2014
12. Define the following terms:
 (i) Sorption
 (ii) Tyndall effect
 (iii) Electrophoresis Delhi 2014C
13. Define the following terms:
 (i) Adsorption
 (ii) Peptisation
 (iii) Sol Delhi 2014C
14. Give reasons for the following observations:
 (i) A delta is formed at the meeting point of sea water and river water.
 (ii) NH_3 gas adsorbs more readily than N_2 gas on the surface of charcoal.
 (iii) Powdered substances are more effective adsorbents. Foreign 2015
15. Define the following terms:
 (i) Electrophoresis
 (ii) Adsorption
 (iii) Shape selective catalysis Delhi 2015C
16. Differentiate between adsorption and absorption.
 Out of MgCl_2 and AlCl_3 , which is more effective in causing coagulation of negatively charged solution and why?
 Out of sulphur sol and proteins, which one forms multimolecular colloidal Delhi 2016
17. Write four distinguishing features operative between chemisorption and physisorption. Foreign 2011
18. Write any three differences between physisorption and chemisorption. All India 2015
19. Write the differences between physisorption and chemisorption with respect to the following:

		Section-E : Long Answer
(i) Specificity (ii) Temperature dependence (iii) Reversibility (iv) Enthalpy change	Delhi 2013	1. Write three distinctive features of chemisorption which are not found in physisorption. All India 2012; Foreign 2010, 2009
19. Distinguish between chemical adsorption and physical adsorption.	Tamil Nadu Board-2015	2. What is an adsorption isotherm? Describe Freundlich's adsorption isotherm. All India 2010
20. What are auxochromes? Give an example.	Tamil Nadu Board-2016	3. Discuss the effect of pressure and temperature on the adsorption of gases on solids. Describe the application of adsorption in controlling humidity. All India 2010C
21. Write two difference between physisorption and chemisorption.	West Bengal Board-2019	4. How do the size of particles of adsorbent, pressure of gas and temperature influence the extent of adsorption? Delhi 2000C
22. Describe Langmuir Adsorption isotherm.	Gujarat Board-2019	5. Giving appropriate examples, explain how the two types of processes of adsorption (physisorption and chemisorption) are influenced by the prevailing temperature, the surface area of adsorbent and the activation energy of the process? Delhi 2014C
23. Write any two features that distinguish between physisorption and chemisorptions.	Jharkhand Board-2019	6. Write the mathematical expression for the Freundlich adsorption isotherm and draw the graph $\log \frac{X}{y}$ vs $\log P$. Assam Board-2022
24. Why does physisorption decrease with the increase of temperature?	Assam Board-2014	7. a) Write any two differences between physisorption and chemisorptions. b) Name the phenomenon/effect for the following (i) Colloidal particles are in zig zag motion. (ii) When an electrical potential is applied across two platinum electrodes dipping in a colloidal solution, Particles m & ve towards one or the other electrodes (iii) Scattering of light by colloidal solution. Karnataka Board-2015
25. Define adsorption. Give one example	Haryana Board-2017	8. a) Give any three differences between physisorption and chemisorptions. b) (i) Mention the role of alum in the purification of drinking water (ii) Give an example for oil dispersed in water emulsion. Karnataka Board-2014
26. Differentiate in followings— (a) Ores and Minerals (b) Flux and Slag (c) Smelting and Roasting	Uttarakhand Board-2019	9. Draw a neat labelled diagram to show the preparation of colloids by Bredig arc method. What is peptization? Give two points of distinction between physisorption and chemisorptions with respect to specificity and nature of forces between adsorbate and adsorbent. Goa Board-2018
27. Give comparison between physical and Chemical Adsorption. (OR) Write short notes on the following— (a) Peptisation (b) Dialysis (c) Hardy-Schulze Rule	Uttarakhand Board-2019	10. (a) i) Give any two characteristics of Chemisorptions. ii) What is meant by selectivity of a catalyst? (b) Define: (i) Brownian movement (ii) Tyndall effect. Karnataka Board-2015
28. Write three features which distinguish physisorption from chemisorption.	Manipur Board-2019	
29. Explain adsorption from solution phase? Write Freundlich equation related to it?	Rajasthan Board-2016	
30. Distinguish between chemical and physical adsorption.	Gujarat Board-2017	
31. Why are powdered substances more effective adsorbent than their crystalline forms?	Haryana Board-2016	
32. Why does physisorption decrease with increase of temperature?	Assam Board-2018	
33. Why are powdered substances more effective adsorbents than their crystalline forms?	Assam Board-2018	
34. (a) What is an adsorption isotherm? (b) Give the equation for Freundlich adsorption isotherm for a gas adsorbed by a solid. (c) Why are powdered substances more effective adsorbents than their crystalline forms?	Meghalaya Board-2021	
35. Write three differences between physical adsorption and chemical adsorption.	Nagaland Board-2018	

11. (i) Write any two characteristics of Chemisorption.

(ii) Why are finely powdered substances more effective adsorbents than their crystalline form?

Kerala Board-2021

12. Give two differences between physical adsorption and chemical adsorption.

Haryana Board-2018

13.(a) Write definition of adsorption.

(b) What happens when an electric current is passed through colloidal solution?

(c) Why alum is added for purification of water?

(d) Draw a labelled diagram of electro dialysis method for purification of colloidal solutions.

Rajasthan Board-2019

14. Write the name of adsorbent used in following-

(a) To remove colouring matter from solution.
(b) In gas mask.

Rajasthan Board-2017

15. Write two differences between physical adsorption and chemical adsorption.

Rajasthan Board-2013

16. Explain Langmuir adsorption isotherm.

Gujarat Board-2018

17. Write the difference between physical adsorption and chemical adsorption. (any six points).

Gujarat Board-2019

18. What are the differences between physisorption and chemisorption? Give reason why a finely divided substance is more effective as an adsorbent.

Assam Board-2019

19. What is an adsorption isotherm? In reference to Freundlich adsorption isotherm write the expression for absorption of gases on solids in the form of an equation.

Assam Board-2019

20. What are adsorption and absorption processes? Give one suitable example to show the distinction between the two.

Assam Board-2015

21. Mention any two factors which distinguish physisorption from chemisorption.

Assam Board-2013

22. What is Chemical Adsorption? Discuss the main characteristics of chemical adsorption.

J & K Board-2021

23.(a) Distinguish between physical adsorption and Chemical adsorption.

(b) What do you mean by selectivity of a catalyst?

(c) State Hardy-Schulze rule.

Meghalaya Board-2019

C. Catalysis

Section-A : Multiple Choice Questions

1. For the titration between oxalic acid and sodium hydroxide, the indicator used is
(a) potassium permanganate
(b) phenolphthalein
(c) litmus
(d) methyl orange.

Tamil Nadu Board-2011

Ans. (b)

2. Role of a catalyst is to change:

- (a) Gibbs energy of reaction
(b) Enthalpy of reaction
(c) Activation energy of reaction
(d) None of the above

Haryana Board-2017

Ans. (c)

3. A catalyst increases the rate of reaction, then what will be the effect on rate constant?

- (a) Increases (b) Decreases
(c) Not Changed (d) None of these

Haryana Board-2018

Ans. (a)

4. A catalyst

- (a) Always slows down a reaction
(b) Starts a reaction that does not occur in its absence
(c) Changes the relative concentration of the reactants and products at equilibrium
(d) Changes the rate of reaction

ISC Board-2004

Ans. (d)

Section-B : Very Short Answer

1. Define Catalyst and Activation Energy.

Haryana Board 2023

2. What is meant by "Selectivity of Catalyst"?

Karnataka board 2023

3. Give one example for heterogeneous catalysis.

Karnataka board 2023

4. Define shape-selective catalysis. Name the process by which alcohols convert directly into gasoline and give a variety of hydrocarbons.

CBSE-2020

5. How will you prepare arsenic sulphide sol in the lab ?

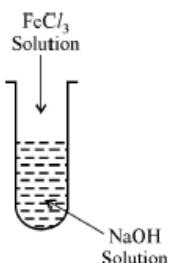
CBSE-2019

6. Give an example of heterogeneous catalysis.

CBSE-2019

7. (i) What is the role of activated charcoal in gas mask ?

- (ii) A colloidal sol is prepared by the given method in figure. What is the charge on hydrated ferric oxide colloidal particles formed in the test tube ? How is the sol represented ?



- (iii) How does chemisorption vary with temperature ? CBSE-2019
8. What is meant by promoter? Give an example. ISC Board-2011
9. What are biocatalysts? Give an example. Foreign 2014, Delhi 2012
10. Define electrophoresis. Delhi 2011; All India 2008; Foreign 2008
11. In reference to surface chemistry, define dialysis. Delhi 2015C
12. What is meant by shape-selective catalysis? Delhi 2014 C
Foreign 2012
All India 2012, 2011, 2009
Delhi 2011
13. Give an example of shape-selective catalysis. Delhi 2010
Foreign 2010
14. Name the two groups into which phenomenon of catalysis can be divided. Give an example of each group with the chemical equation involved. Delhi 2012
15. What are biocatalysts? Give an example. Foreign 2014
16. Out of NH₃ and CO₂, which gas will be adsorbed more readily on the surface of activated charcoal and why? Delhi 2012
17. CO (g) and H₂ (g) react to give different products in the presence of different catalysts. Which ability of the catalyst is shown by these reactions ? UP Board-2018
18. Which polymer is prepared by the monomer, styrene? Jharkhand Board-2020
19. What is catalysis ? How is catalysis classified ? Give two examples for each type of catalysis. Andhra Pradesh Board-2016
20. Read the given paragraph and write answers of the following questions.
When any solid substance is kept in contact with liquid or gas, then liquid or gas are more adsorbed on the surface of solid rather than bulk. The process is known as adsorption. It is different from absorption. Many gaseous reaction occurs in the presence of solid catalyst. Catalyst is a chemical substance which change

the rate of reaction without undergoing itself change. This phenomenon is known as catalysis.

- (a) Write any two differences between absorption and adsorption.
(b) Write any chemical equation of heterogeneous catalysis.
(c) Write the name of Zeolit catalyst used to convert Alcohol to Petrol

Rajasthan Board-2018

21. Give one example of a biochemical catalyst. Assam Board-2017
22. What are catalytic promoters? Given one example. MP Board-2018
23. What is meant by selectivity of a catalyst ? Nagaland Board-2017

Section-C : Short Answer

1. Define the following terms :
(i) Shape-selective catalysis
(ii) Kraft temperature
(iii) Peptization CBSE-2020
2. Explain what is observed when
(i) an electric current is passed through a sol?
(ii) a beam of light is passed through a sol?
(iii) an electrolyte (say NaCl or KCl) is added to ferric hydroxide sol (or hydrated ferric oxide sol)? All India 2011, 2008;
Foreign 2010, 2009
Delhi 2008C
3. Describe the following processes:
(i) Dialysis
(ii) Electrophoresis
(iii) Tyndall effect All India 2015C
4. Define shape-selective catalysis. Give an example. Assam Board-2022
5. Write any three general characteristics of catalytic reaction. Tamil Nadu Board-2011
6. Explain the adsorption theory of catalysis. Tamil Nadu Board-2018
7. What do you mean by activity and selectivity of catalysts ? Haryana Board -2016
8. (a) Catalysis can be classified into two groups - homogeneous and heterogeneous.
(a) What do you mean by homogenous catalysis?
(b) Write one example for heterogeneous catalysis. Kerala Board-2016
9. What is shape selective catalysis Rajasthan Board-2017
10. What is enzyme catalysis ? Write an example. Rajasthan Board-2015
11. Which type of emulsion is milk ? Explain. Rajasthan Board-2015

Section-E : Long Answer

- Explain the intermediate compound formation theory of catalysis
Tamil Nadu Board-2011
- Define positive and negative catalysis.
Haryana Board-2017
- Briefly explain the effect of adding catalyst on rate of reaction.
Haryana Board-2016
- What do you understand by homogeneous catalysis and heterogeneous catalysis
Haryana Board-2018
- What is shape selective catalysis? Describe some features of catalysis by zeolites.
Assam Board-2020
- Define homogeneous and heterogeneous catalysis. Give one suitable example each of the two catalysis.
Assam Board-2015

D. Colloids and Classification of Colloids

Section-A : Multiple Choice Questions

- is the example of colloid in which dispersed phase is liquid and dispersion medium is gas.
(a) froth (b) fog
(c) smoke (d) cell fluids
- From following ions which has highest coagulating power for coagulation of As_2S_3 ?
(a) Na^+ (b) K^+
(c) Ba^{2+} (d) Al^{3+}

Gujarat Board 2023 (March)

Ans. (b)

- Colour of colloidal solution depends on _____
(a) Size of particles (b) Nature of particles
(c) Position of observer (d) A, B, C all

Gujrat Borad-2022 (July)

Ans. (d)

- From following which is the example of solution in which solute is gas and solvent is solid?
(a) Aqueous solution of oxygen
(b) Chloroform mixed with nitrogen gas
(c) Camphor in nitrogen gas
(d) Solution of hydrogen in palladium

Gujarat Borad-2022 (July)

Ans. (d)

- The charge on colloidal particles of $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ is
(a) Negative (b) Positive
(c) No charge (d) None of these

UP Board 2023

Ans. (a)

- Colloidal antimony is used in curing of –
(a) Kalaazar (b) Stomach disorders
(c) Skin disease (d) Sexual disease

Rajasthan Board 2023

Ans. (a)

- Hardening of leather in tanning industry is based on
(a) Electrophoresis (b) Electro-osmosis
(c) Mutual coagulation (d) Tyndall effect

CBSE-2020

Ans. (c)

- In the following, which type of colloidal system is Fog–
(a) Aerosol (b) Gel
(c) Emulsion (d) Sol

Uttarakhand Board-2020

Ans. (a)

- Which of the following is example of sol?
(a) Paint (b) Fog
(c) Jellies (d) Milk

Gujarat Board-2021

Ans. (a)

- The dispersed phase and dispersion medium in smoke are respectively
(a) Gas and liquid
(b) Liquid and gas
(c) Solid and gas
(d) Solid and liquid

Odisha Board-2020

Ans. (c)

- Haze is a colloidal solution of:
(a) Gas in liquid
(b) Liquid in gas
(c) Gas in solid
(d) solid in gas

Tamil Nadu Board-2015

Ans. (d)

- An emulsion is a colloidal solution of:
(a) Two solids
(b) Two liquids
(c) Two gases
(d) One solid one liquid

Tamil Nadu Board-2015

Ans. (b)

- The phenomenon of Tyndall's effect is not observed in:
(a) Emulsion
(b) Colloidal solution
(c) True solution
(d) none

Tamil Nadu Board-2015

Ans. (c)

- In the manufacture of ammonia by Haber's process, the maximum yield of ammonia will be obtained with the process having

- (a) low pressure and high temperature
- (b) low pressure and low temperature
- (c) high pressure and high temperature
- (d) high pressure and low temperature

Tamil Nadu Board-2011

Ans. (d)

- 15. Colloidal medicines are more effective because**
- (a) they are clean
 - (b) they are easy to prepare
 - (c) the germs move towards them
 - (d) they are easily assimilated and adsorbed.

Tamil Nadu Board-2011

Ans. (d)

- 16. FeCl_3 solution is applied to stop bleeding because**
- (a) Cl^- ions coagulate positively charged blood solution.
 - (b) Cl^- ions coagulate negatively charged blood solution.
 - (c) Fe^{3+} ions coagulate negatively charged blood solution.
 - (d) Fe^{3+} ions coagulate positively charged blood solution.

NIOS Board-2019

Ans. (c)

- 17. The colloidal solutions are purified by :**
- | | |
|-----------------|--------------------|
| (a) Peptisation | (b) Coagulation |
| (c) Dialysis | (d) Emulsification |

NIOS Board-2019

Ans. (c)

- 18. Paramagnetism is common in:**
- (a) s-block elements
 - (b) p-block elements
 - (c) f-block elements
 - (d) d-block elements

Tamil Nadu Board-2018

Ans. (d)

- 19. Which of the following impurity can be removed by electrodialysis method?**
- (a) Urea
 - (b) Ferric chloride
 - (c) Glucose
 - (d) Sugar

Tamil Nadu Board-2018

Ans. (b)

- 20. Cheese is an example of:**
- | | |
|---------------|----------|
| (a) Aerosol | (b) Foam |
| (c) Solid sol | (d) Gel |

Tamil Nadu Board-2018

Ans. (d)

- 21. The size of colloidal particles is in between**
- (a) 10^{-7} cm and 10^{-9} cm
 - (b) 10^{-4} cm and 10^{-7} cm
 - (c) 10^{-9} cm and 10^{-11} cm
 - (d) 10^{-2} cm and 10^{-3} cm

NIOS Board-2016

Ans. (b)

- 22. Dispersion medium in Aerosol Colloid is:**

- (a) Air
- (b) Water
- (c) Alcohol
- (d) Benzene

Haryana Board-2022

Ans. (a)

- 23. According to Hardy-Schulze rule, which of the following has highest flocculating power ?**

- (a) Al^{3+}
- (b) Ba^{2+}
- (c) Na^+
- (d) None of the above

Haryana Board-2019, 2021

Ans. (a)

- 24. Which type of property is Brownian moment in a colloidal solution.**

- (a) Electrical
- (b) Optical
- (c) Mechanical
- (d) Colligative

J&K Board-2019

Ans. (c)

- 25. Which one of the following has minimum gold number?**

- (a) Gelatin
- (b) Starch
- (c) Gum arabic
- (d) Sodium oleate

Haryana Board-2017

Ans. (a)

- 26. Which property of colloids is not dependent on the charge on colloidal particles?**

- (a) Coagulation
- (b) Electro-osmosis
- (c) Tyndall effect
- (d) None of these

Haryana Board-2017

Ans. (c)

- 27. Blue colour of sky is due to :**

- (a) Scattering of light
- (b) Transmission of light
- (c) Absorption of light
- (d) None of these

Haryana Board -2016

Ans. (a)

- 28. In following, the Lyophilic Colloid is–**

- (a) Milk
- (b) Gum
- (c) Blood
- (d) None of these

Uttarakhand Board-2019

Ans. (b)

- 29. The Tyndall's effect associated with colloidal particle is due to:**

- (a) Presence of charge
- (b) Scattering of light
- (c) absorption of light
- (d) reflection of light

Tamilnadu Board, Sep.-2016

Ans. (b)

- 30. Which of the following will form a reversible sol?**

- (a) Sulphur sol
- (b) Rubber sol
- (c) Gold sol
- (d) Arsenious sulphide sol

Gujarat Board-2018

Ans. (b)

- | | | | | | |
|-----|---|----------------------------|-----|---|--------------------------------|
| 17. | Identify the dispersed phase and dispersion medium in the following colloidal solutions:
(a) Cheese
(b) Paints | CBSE-2019 | 32. | Write the dispersed phase and dispersion medium of the following colloidal systems:
(i) Smoke
(ii) Milk | All India 2013 |
| 18. | Which of the following electrolytes is most effective for the coagulation of As_2S_3 sol and why?
AlCl_3 , KCl , CaCl_2 | CBSE-2019 | 33. | What is the coagulation process? | All India 2009 |
| 19. | Give reasons :
(a) Brownian movement provides stability to the colloidal solution
(b) Leather gets hardened on tanning | CBSE-2019 | 34. | What causes Brownian movement in a colloidal solution? | Delhi 2008; Foreign 2008 |
| 20. | Write the main reason for the stability of colloidal sols. | CBSE-2019 | 35. | Explain the following:
(i) Same substance can act both as colloids and crystalloids.
(ii) Artificial rain is caused by spraying salt over clouds. | Delhi 2013C |
| 21. | Define associated colloid with an example. | CBSE-2019 | 36. | How are the following colloidal solutions prepared?
(i) Sulphur in water
(ii) Gold in water | Delhi 2013C |
| 22. | What is the difference between a colloidal solution and emulsion? What is the role of emulsifier in forming emulsion? | Delhi 2010, 2008C | 37. | How can a colloidal solution and true solution of the same colour be distinguished from each other? | Delhi 2012C |
| 23. | Distinguish between micelles and colloidal particles. Give one example of each. | All India 2008C | 38. | What is especially observed when a beam of light is passed through a colloidal solution? | All India 2013 |
| 24. | Define the following terms.
(i) Aerosol
(ii) Coagulation of colloids | Foreign 2011 | 39. | To which colloidal system does milk belong? | All India 2013C |
| 25. | Define each of the following terms.
(i) Micelles
(ii) Peptisation | Delhi 2011 | 40. | Write the dispersed phase and dispersion medium of butter. | All India 2015
foreign 2014 |
| 26. | Define the following terms.
(i) Peptisation
(ii) Reversible sols | All India 2010 | 41. | What are the dispersed phase and dispersion medium in milk? | Delhi 2014 |
| 27. | How are associated colloids different from macromolecular colloids? Give one example of each type. | Delhi 2010, 2009C | 42. | What type of colloid is formed when a liquid is dispersed in a solid? Give an example. | All India 2017 |
| 28. | What is meant by coagulation of a colloidal solution? Describe briefly any three methods by which coagulation of lyophobic sols can be carried out. | Delhi 2012; All India 2010 | 43. | What type of colloid is formed when a gas is dispersed in a liquid? Give an example. | All India 2017 |
| 29. | What is the difference between multimolecular and macromolecular colloids? Give one example of each. | Delhi 2013 | 44. | What is the reason for stability of colloidal sols? | Delhi 2016 |
| 30. | What are the characteristics of the following colloids? Give one example of each.
(i) Multimolecular colloids
(ii) Lyophobic sols | All India 2013 | 45. | Out of BaCl_2 and KCl , which one is more effective in causing coagulation of a negatively charged colloidal sol? Give reason. | Delhi 2015 |
| 31. | Define the following terms giving an example of each.
(i) Associated colloids
(ii) Lyophilic sol | All India 2013 | 46. | What is Brownian motion and how does it arise? | NIOS Board-2015 |
| 32. | Write down the differences between lyophilic and lyophobic colloids. | Odisha Board-2023 | 47. | Define the following terms:
(a) Macromolecular colloids
(b) Associated colloids | NIOS Board-2021 |
| 33. | | | 48. | | |

- | | | | | | |
|-----|---|----------------------------|-----|---|------------------------|
| 49. | Explain Brownian movement. | NIOS Board-2018 | 69. | Give two differences between Lyophilic colloids and Lyophobic colloids. | MP Board-2016 |
| 50. | Define collision frequency. | Karnataka Board-2017 | 70. | Conversion of precipitate into colloidal solution is known as. | MP Board-2016 |
| 51. | What is coagulation? Why does clotting of blood take place on applying FeCl_3 solution? | NIOS Board-2016 | 71. | Colloidal solution of solid in liquid is called What is Tyndall effect? | MP Board-2014 |
| 52. | What is the particle size of colloidal solution? | Jharkhand Board-2018 | 72. | Why does colloidal particle show Tyndall effect? | MP Board-2013 |
| 53. | Milk coagulates when acid is added, why? | Chhattisgarh Board-2021 | 73. | Match of pairs (choose the correct answer from Section 'B' for Section 'A'): | |
| 54. | What is coagulation? | Chhattisgarh Board-2020 | | | |
| 55. | Write dispersed phase and dispersion medium of dust, a colloidal solution. | Jharkhand Board-2020 | | | |
| 56. | Draw a neat labelled diagram of the electrodialysis process used for the purification of a colloidal solution? | Goa Board-2019 | | | |
| 57. | Give examples of colloidal system of
(a) Liquid in solid
(b) Gas in solid | Andhra Pradesh Board-2021 | | | |
| 58. | Draw a labelled diagram of electrical dispersion method for preparation of colloidal solution. | Rajasthan Board-2020 | 74. | Explain the properties of colloidal solution by electrophoresis. | Nagaland Board-2021 |
| 59. | Arrange the following ions according to their flocculation power in the coagulation of negative sol.
Na^+ , Al^{3+} , Ba^{2+} | Rajasthan Board-2016 | | | |
| 60. | Explain inert pair effect. | Rajasthan Board-2011 | | | |
| 61. | Give the dispersed phase and dispersion medium for a gel. Give example for gel. | Tamilnadu Board, Sep.-2016 | 1. | Clarify the difference between lyophobic and lyophilic solution on the basis of following properties:
(i) Viscosity
(ii) Effect of electrolyte
(iii) Surface tension
(iv) Electric charge. | UP Board 2019 |
| 62. | Coagulation | Assam Board-2016 | 2. | Give reasons for the following statements:
(a) smoke from fire often has blue tinge
(b) Geltin is generally added to ice cream
(c) Lyophilic sols are called reversible colloids | Manipur Board 2020 |
| 63. | Dialysis | Assam Board-2016 | 3. | What are the observations in following cases-
(a) When a beam of light is passed through a Colloidal Sol
(b) An electrolyte NaCl is added to hydrated Ferric Oxide Sol
(c) Electric current is passed through a Colloidal Sol | Uttarakhand Board 2022 |
| 64. | Liquid-; liquid sols are known as _____.
(a) What is observed when a beam of light is passed through a colloidal solution?
(b) What are lyophobic colloids? Give one example. | Assam Board-2013 | 4. | Define the following terms :
(i) Protective colloid
(ii) Zeta potential
(iii) Emulsifying agent | |
| 65. | Colloidal solution of liquid in liquid is known as _____. MP Board-2018 | MP Board-2018 | | | |
| 66. | Write Bragg's equation. | MP Board-2017 | | | |
| 67. | Fill the blanks:
(b) The substance on whose surface adsorption takes place is called_____ | MP Board-2017 | | | |
| 68. | What is tyndall effect. | MP Board-2016 | | | |

Section 'A'		Section 'B'	
K	Gold Sol Rule	i	Hardy-Schulze
L	Gold No. Force	ii	Vander Waals
M	Coagulation Power	iii	Electro-chemical phenomenon
N	Physical Adsorption	iv	Lyophilic
O	Corrosion	v	Lyophobic colloid
		vi	Tyndall effect

MP Board-2012

74. Explain the properties of colloidal solution by electrophoresis.

Section-C : Short Answer

1. Clarify the difference between lyophobic and lyophilic solution on the basis of following properties:
(i) Viscosity
(ii) Effect of electrolyte
(iii) Surface tension
(iv) Electric charge.

UP Board 2019

2. Give reasons for the following statements:
(a) smoke from fire often has blue tinge
(b) Geltin is generally added to ice cream
(c) Lyophilic sols are called reversible colloids

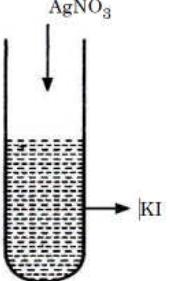
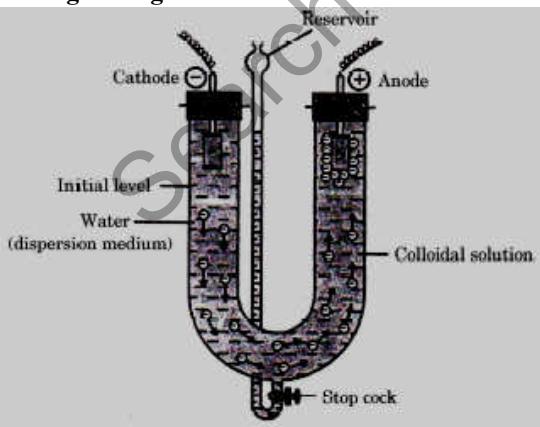
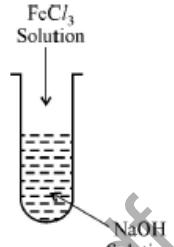
Manipur Board 2020

3. What are the observations in following cases-
(a) When a beam of light is passed through a Colloidal Sol
(b) An electrolyte NaCl is added to hydrated Ferric Oxide Sol
(c) Electric current is passed through a Colloidal Sol

Uttarakhand Board 2022

4. Define the following terms :
(i) Protective colloid
(ii) Zeta potential
(iii) Emulsifying agent

CBSE-2020

5. Define the following terms with a suitable example in each:
 (i) Multimolecular colloid
 (ii) Sol
 (iii) Adsorption
- CBSE-2022
6. Observe the given figure and answer the following questions : (Any tow)
- 
- (i) What is the charge on AgI colloidal particles ?
 (ii) What is the reason for the origin of the charge on AgI ?
 (iii) If KI is added to AgNO₃. What will be the charge on AgI colloidal particles ?
- CBSE-2022
7. (I) Define the following terms:
 (i) Zeta Potential
 (ii) Coagulation
 (II) Why a negatively charged sol is obtained when AgNO₃ solution is added to KI solution?
- CBSE-2022
8. Define the following terms with a suitable example in eachs:
 (i) Lyophilic sol
 (ii) Macromolecular colloid
 (iii) Coagulation
- CBSE-2022
9. Answer the following questions on the basis of the given figure :
- 
- (a) Define the process depicted in the above figure.
 (b) Can this process be used in the coagulation of the lyophobic sols ?
 (c) What is coagulation ?
- CBSE-2022
10. What type of colloid is formed when a liquid is dispersed in a solid? Give an example.
- CBSE-2019
11. (i) What is the role of activated charcoal in gas mask ?
 (ii) A colloidal sol is prepared by the given method in figure. What is the charge on hydrated ferric oxide colloidal particles formed in the test tube ? How is the sol represented ?
- 
- (iii) How does chemisorption vary with temperature ?
- CBSE-2019
12. Define the following :
 (a) Associated colloids
 (b) Electrophoresis
 (c) Zeta potential
- CBSE-2019
13. Define the following terms :
 (a) Coagulation
 (b) Associated colloids
 (c) Brownian movement
- CBSE-2019
14. Give reasons for the following :
 (a) Brownian movement provides stability to the colloidal solution.
 (b) True solution does not show Tyndall effect.
 (c) Addition of alum purifies the water.
- CBSE-2019
15. Define the following terms with a suitable example of each :
 (a) Sol
 (b) Aerosol
 (c) Hydrosol
- CBSE-2019
16. Define the following with a suitable example, of each:
 (a) Coagulation
 (b) Multimolecular colloid
 (c) Gel
- CBSE-2019
17. (a) Out of starch and ferric hydroxide sol, which one can easily be coagulated and why?
 (b) What is observed when an emulsion is centrifuged?
 (c) What is the role of promoters and poisons in catalysis?
- CBSE-2019

18. Explain the following terms:
 (i) Electrophoresis
 (ii) Coagulation
 (iii) Hydrosol Tyndall effect
 All India 2010, 2009C
19. Explain the following terms:
 (i) Electrophoresis
 (ii) Dialysis
 (iii) Tyndall effect
 All India 2011, 2009C
20. Distinguish between multimolecular, macromolecular and associated colloids. Give one example of each.
 Delhi 2011C
21. What is the difference between multimolecular and macromolecular colloids? Give one example of each type. How are associated colloids different from these two types of colloids?
 Delhi 2010; foreign 2010, 2008
22. Classify colloids where the dispersion medium is water. State their characteristics and write an example of each of these classes.
 All India 2011
23. Differentiate among a homogeneous solution, a suspension and a colloidal solution, give a suitable example of each.
 Foreign 2012
24. Define the following terms
 (i) lyophilic colloidal
 (ii) zeta potential
 (iii) associated colloids
 All India 2015C
25. Write one difference in each of the following:
 (i) Multimolecular colloid and associated colloid.
 (ii) Coagulation and peptisation.
 (iii) Homogeneous catalysis and heterogeneous catalysis.
 All India 2017
26. (i) Some substances can act both as colloids and crystalloids. Explain.
 (ii) What will be the charge on AgI colloidal particles when it is prepared by adding small amount of AgNO_3 solution to KI solution in water? What is responsible for the development of this charge?
 Delhi 2012C
27. (a) What is Tyndall effect?
 (b) Coagulation takes place when Sodium Chloride solution is added to Colloidal solution of Ferric Hydroxide, why?
 Uttarakhand Board-2020
28. Explain in detail : lyophilic colloids and lyophobic colloids.
 Gujarat Board-2021
29. Explain : Brownian Movement.
 Gujarat Board-2021
30. Draw a neat labelled diagram of the electrodialysis process used for the purification of a colloidal solution?
 Goa Board-2023
31. Explain coagulation of colloids.
 Gujarat Board-2016
32. How can colloidal solutions be purified by dialysis?
 Tamil Nadu Board-2011
33. Explain the formation of nitrogen molecule by molecular orbital theory.
 Tamil Nadu Board-2011
34. What is meant by Tyndall effect?
 Tamil Nadu Board-2011
35. What is meant by Buffer solution? Mention its types.
 Tamil Nadu Board-2011
36. Define the following given an example of each:
 (a) Coagulation
 (b) Tyndall effect.
 Manipur Board-2017
37. (a) What are nanomaterials? Give their any two applications.
 (b) Differentiate between macromolecular and multi-molecular colloids giving one example of each?
 NIOS Board-2018
38. What are lyophobic colloids? Given an example.
 Tamil Nadu Board-2016
39. What is Tyndall effect?
 Tamil Nadu Board-2018
40. What is a colloidal solution? How do true solutions, colloidal solutions and suspensions differ with one another in respect to (a) visibility and (b) settling of particles?
 NIOS Board-2013
41. Define Tyndall effect. Differentiate between electrophoresis and electroosmosis.
 Punjab Board-2017
42. What is difference between multimolecular and macromolecular colloids? Give one example of each.
 Haryana Board-2021
43. Define the following terms :
 (a) Adsorbent
 (b) Brownian movement.
 Jharkhand Board-2018
44. a) Write any two applications of adsorption.
 b) i) What is 'Tyndall effect'?
 ii) In the coagulation of negative sol, arrange the following ions in ascending order of their flocculating power. Ba^{2+} , Na^+ , Al^{3+}
 What is Heterogeneous catalysis? (2 + 2 + 1)
 Karnataka Board-2016
45. (a) State Hardy - Schulze rule with the help of example.
 (b) Why lyophilic colloids are used as protective colloids?
 Kerala Board-2018

46. Draw a neat labelled diagram to show the purification of a colloidal solution by dialysis.
Goa Board-2019
47. Write notes on:
 (a) Brownian movement
 (b) Protection of colloids
Chhattisgarh Board-2020
48. What is zeta potential? Explain briefly.
Haryana Board-2016
- 49.(a) Which of the following is Lyophobic colloid?
 (i) Starch in water
 (ii) Gum in water
 (iii) Soap in water
 (iv) Gold sol
(b) Write four applications of colloids.
Kerala Board-2015
50. What are dispersed phase and dispersion medium in a colloid ? Which substance is present as dispersion medium in aquasols.
Manipur Board-2022
51. Describe the purification of colloidal solutions by Dialysis method with a neat diagram.
Andhra Pradesh Board-2018
52. Give a detailed account of the collision theory of reaction rates of Bimolecular gaseous reactions.
Andhra Pradesh Board-2016
53. Discuss the Tyndall effect.
Haryana Board-2018
54. Explain with chemical equation. What happens when white phosphorous is heated at 473 K and very high pressure?
Rajasthan Board-2018
55. (i) Define coagulating value of sol.
 (ii) Arrange the following ions in increasing order on the basis of their coagulating values.
Rajasthan Board-2017
56. What happens when hydrated ferric oxide sol is mixed with arsenious sulphide sol ?
Rajasthan Board-2015
57. Explain Tyndall effect with labelled diagram.
Rajasthan Board-2015
58. Describe the method for the preparation of gold colloidal sol with diagram.
Rajasthan Board-2014
59. What is the difference between a sol and a gel ?
Rajasthan Board-2014
60. What is coagulation ? Explain.
Rajasthan Board-2014
61. Draw labelled diagram of electro-dialysis.
Rajasthan Board-2013
62. Give the dispersion medium and dispersed phase in the following colloids:
 (a) Milk (b) Smoke
Rajasthan Board-2010
63. Draw the diagram showing Tyndall effect.
Rajasthan Board-2010
64. Why colloidal system in gas in gas does not exist?
Tamilnadu Board, March-2016
65. What is observed when a beam of light is passed through a colloidal solution?
Assam Board-2020
66. What is coagulation? Explain the Hardy and Schulze rules.
Gujarat Board-2018
67. Give the decreasing order of flocculating power of the following ions in the coagulation of a negative sol.
 Na^+ , Ba^{2+} , Al^{3+} .
Assam Board-2018
68. (a) Define shape-selective catalysis. Give an example of such catalyst.
 (b) Explain what is observed when:
 (i) An electrolyte is added to hydrated ferric oxide sol.
 (ii) Direct electric current is passed through colloidal sol.
Assam Board-2012
69. What is gold number?
MP Board-2015

Section-D : Case Based Study

Read the given passage and answer the questions 1 to 5 that follow :

Colloidal particles always carry an electric charge which may be either positive or negative. For example, when AgNO_3 solution is added to KI solution, a negatively charged colloidal sol is obtained. The presence of equal and similar charges on colloidal particles provide stability to the colloidal sol and if, somehow, charge is removed, coagulation of sol occurs. Lyophobic sols are readily coagulated as compare to lyophilic sols.

1. What is the reason for the charge on sol particles ?
CBSE-2020
2. Why the presence of equal and similar charges on colloidal particles provide stability ?
CBSE-2020
3. Why a negatively charged sol is obtained on adding AgNO_3 solution to KI solution ?
CBSE-2020
4. Name one method by which coagulation of lyophobic sol can be carried out.
CBSE-2020
5. Out of KI or K_2SO_4 , which electrolyte is better in the coagulation of positive sol ?
CBSE-2020
6. Comprehension:-
 Lyophilic sols are more stable than lyophobic sols. This is due to the fact that lyophilic colloids are extensively solvated, i.e., colloidal particles are covered by a sheath of the liquid in which they are dispersed.
 Lyophilic colloids have a unique property of protecting lyophobic colloids. When a lyophilic sol is added to the lyophobic sol, the lyophilic particles form a layer around lyophobic particles and thus protect the latter from electrolytes. Lyophilic colloids used for this purpose are called protective colloids

Answer the following:

13. Give one example each of 'oil in water' and 'water in oil' emulsion.	6. How are the following colloids different from each other in respect of their dispersion medium and dispersed phase? Give one example of each.															
All India 2014	(i) Aerosol (ii) Emulsion (iii) Hydrosol															
14. Give one example of sol and gel.	7. Explain the following terms giving a suitable example for each.															
All India 2014	(i) Aerosol (ii) Emulsion (iii) Micelle															
15. What are emulsions? Give an example.	8. Define the following terms with an example in each case.															
All India 2015C	(i) Macromolecular sol (ii) Peptisation (iii) Emulsion															
16. Define emulsion.	9. What are emulsions? What are their different types? Give one example of each type.															
Delhi 2010, Foreign 2009; all India 2014C	Delhi 2014															
17. Match the pairs correctly (Choose the correct answer from Section 'B' for Section 'A'):	10. How do emulsifiers stabilize emulsion? Name two emulsifiers.															
Section 'A' Section 'B'	Assam Board-2022															
(a) Emulsion	(i) NaCl															
(b) Body-centred cubic	(ii) Lyophilic colloid cell															
(c) Gold No.	(iii) AgBr															
(d) Schottky defect	(iv) Lyophobic colloid															
(e) Frenkel defect	(v) CsCl															
	(vi) FeCl ₂															
	(vii) Milk															
	MP Board-2014															
Section-C : Short Answer																
1. 'Action of soap is based on the emulsification and micelle formation'. Comment on it.	11. What are emulsions? How are they classified? Give one example for each.															
UP Board 2023	Telangana Board-2023															
2. Define the following terms with an examples of each.	12. Which types of emulsion is 'Vanishing cream'. Write its appropriate name.															
(i) Lyophilic sol	Rajasthan Board-2017															
(ii) Gel	13. What is the difference between aerosol and foam ?															
(iii) Multimolecular colloid	Rajasthan Board-2014															
	14. What is peptization ? Explain.															
3. What is the role of	Rajasthan Board-2014															
(a) Depressants in froth floatation?	15. For Al(OH) ₃ sol arrange the following in increasing order of their coagulation power:															
(b) Carbon monoxide in Mond's process?	KCl, K ₃ PO ₄ , K ₂ SO ₄ , K ₄ [Fe(CN) ₆]															
(c) Concentrated sodium hydroxide in leaching of alumina from bauxite?	Rajasthan Board-2010															
CBSE-2019	16. What is Emulsion?															
4. Define the following with a suitable example, of each :	MP Board-2015															
(a) Coagulation	Section-E : Long Answer															
(b) Multimolecular colloid	(c) Gel	1. Draw neat and labelled diagram of above emulsion.	CBSE-2019	Rajasthan Board-2017	5. (a) Out of starch and ferric hydroxide sol, which one can easily be coagulated and why ?	2. Explain Electrophoresis with labelled diagram.	(b) What is observed when an emulsion is centrifuged ?	Rajasthan Board-2015	(c) What is the role of promoters and poisons in catalysis ?	3. What are emulsions? What are their different types? Give example of each type.	CBSE-2019	Assam Board-2020		4. Explain Dialysis and electro dialysis.		Haryana Board-2016
(c) Gel	1. Draw neat and labelled diagram of above emulsion.															
CBSE-2019	Rajasthan Board-2017															
5. (a) Out of starch and ferric hydroxide sol, which one can easily be coagulated and why ?	2. Explain Electrophoresis with labelled diagram.															
(b) What is observed when an emulsion is centrifuged ?	Rajasthan Board-2015															
(c) What is the role of promoters and poisons in catalysis ?	3. What are emulsions? What are their different types? Give example of each type.															
CBSE-2019	Assam Board-2020															
	4. Explain Dialysis and electro dialysis.															
	Haryana Board-2016															

06.

General Principles and Processes of Isolation of Elements

A. Occurrence of Metals

Section-A : Multiple Choice Questions

- 1.** **Copper matte contains**

 - (a) Cu_2S , Cu_2O and silica
 - (b) Cu_2S , CuO and silica
 - (c) Cu_2S , FeO and silica
 - (d) Cu_2S , FeS and silica

CBSE-2020

Ans. (d)

2. Aluminium is extracted from alumina by electrolysis of a molten mixture of

 - (a) $\text{Al}_2\text{O}_3 + \text{KF} + \text{NaAl}_3\text{F}_6$
 - (b) $\text{Al}_2\text{O}_3 + \text{Na}_3\text{AlF}_6 + \text{CaF}_2$
 - (c) $\text{Al}_2\text{O}_3 + \text{HF} + \text{Na}_3\text{AlF}_6$
 - (d) $\text{Al}_2\text{O}_3 + \text{NaF} + \text{CaF}_2$

Odisha Board-2020

Ans. (c)

Jharkhand Board-2018

Ans. (b)

Jharkhand Board-2019

Ans. (a)

Gujarat Board 2017

Ans. (b)

4) Monel metal
Gujarat Board-2018

Ans (a)

- Ans. (a)**

7. Brass is:

(a) Solid solution (b) Liquid solution
(c) Compound (d) All of the above

All of these

63

Section-B : Very Short Answer

1. Describe with diagram, method of obtaining pure aluminium from alumina. Write the names and uses of its two main alloys.
UP Board 2019
 2. Mercury is a _____ metal.
MP Board 2020
 3. Write the names of metal elements present in brass.
Rajasthan Board 2022
 4. Name the process used for the benefaction of ores which is based on the difference in the gravities of ore and the gangue particles.
CBSE-2020
 5. Define the following terms:
(i) Roasting
(ii) Calcination
Delhi 2014C
 6. Name two metals which occur in nature as oxides.
Foreign 2009
 7. Write two alloys of copper and their uses.
Tamil Nadu Board-2015
 8. Give an example of a metal purified by Mond process.
Karnataka Board-2017
 9. Giving one example for each, differentiate between 'roasting' and 'calcination'.
NIOS Board-2016
 10. Differentiate between mineral and ore.
NIOS Board-2013
 11. What is Misch metal ? Give its composition and use.
Andhra Pradesh Board-2019
 12. Give the composition of the following alloys :
(a) Brass
(b) Bronze
(c) German silver
Andhra Pradesh Board-2019
 13. Define ore and minerals.

Section-C : Short Answer

- Give the chemical reactions involved in the leaching of alumina from bauxite.
CBSE-2020
 - Explain the process of obtaining “blister copper” from “copper matte” with equations.
Karnataka Board-2018
 - Describe the three steps involved in the leaching of bauxite to get pure alumina (equations not expected).
Karnataka Board-2015
 - What is the action of carbon on the following metal oxides :
(a) Fe_2O_3 in blast furnace
(b) ZnO in vertical retort furnace
Maharashtra board-2018
 - What are interstitial compounds ? Give the classification of alloys with examples.
Maharashtra board-2023
 - (i) Explain the steps involved in the leaching of Bauxite ore.
(ii) What is the role of cryolite in the extraction of Aluminium ?
Kerala Board-2021
 - Differentiate between the following:
(i) Calcination and Roasting
(ii) Pig iron and Wrought iron
(iii) Mineral and Ore.
Kerala Board-2021
 - Give the steps involved in the preparation of potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$) from chromite ore.
Kerala Board-2020
 - What is misch metal? Write its one use.
Rajasthan Board-2010
 - What are alloys? Name the metals used for the formation of bronze.
Assam Board-2019
 - What are alloys? Name the metals used for the formation of bronze.
Assam Board-2015
 - What do you understand by the terms ?
(a) Roasting
(b) Calcination
(c) Smelting
L&K Board 2020

B. Concentration of Ores

Section-A : Multiple Choice Questions

Ans. (a)

MP Board 2020

Ans. (c)

Ans. (c)

4. Which are the constituents of gun metal ?

 - (a) Cu, Sn
 - (b) Cu, Sn, Zn
 - (c) Cu, Sb, Pb
 - (d) Cu, Sn, Sb

NIOS Board-2022

Ans. (b)

Ans. (d)

- Ques. (d)**

6. The ores that are concentrated by froth floatation method are
(a) Carbonates (b) Oxides
(c) Sulphides (d) Phosphates

Goa Board-2019

Ans. (c)

7. Malachite is an ore of
(a) Al
(c) Fe

**(a) एम
Jharkhand Board-2020
Haryana Board-2016**

Ans. (b)

Kerala Board-2016

Ans. (d)

- 9.** Calamine is an ore of
(a) Zn
(c) Cu

(d) Tc
Jharkhand Board-2023
Rajasthan Board 2023

Ans (a)

Section-B : Very Short Answer

- 1. How is leaching carried out in case of low grade Copper Ores?**

Gujarat Board 2023 (March)

2. Write Froth floatation method for concentration of ores. (Figure is not required)

Guirat Borad-2022 (July)

Section-C : Short Answer

1. Write names of components of brass.
Rajasthan Board 2023

2. (a) What is the difference between calamine and malachite ?
(b) Why is zinc used instead of Cu for recovery of Ag from $[\text{Ag}(\text{CN})_2]^-$?
(c) What is the role of cryolite in metallurgy of Al ?
CBSE-2019

3. Give reasons:
(c) Zinc and hot copper is used for the recovery of metallic silver from complex $[\text{Ag}(\text{CN})_2]^-$
(d) Alumina is dissolved in cryolite for electrolysis instead of being electrolysed directly.

- (c) Zinc oxide can be reduced to metal by heating with carbon but not Cr_2O_3 .

CBSE-2019

4. For the extraction of aluminium, write

(i) The most important ore

(ii) One method for the purification of the mentioned ore.

ISC Board-2005, 2006

5. (a) What happens, when (i) bauxite and (ii) calamine are subjected to calcination?
 (b) What is lanthanoid contraction and what are its consequences?

NIOS Board-2014

6. Name any one metal oxide which is not reduced to the metal when heated with carbon. Which process is normally used for the reduction of this oxide ore?

NIOS Board-2011

7. (i) Which type of ores is concentrated by froth floatation process ?
 (ii) What is thermit mixture ? Mention one use of it.

West Bengal Board-2019

8. (A) Define Enantiomers
 (B) How is potassium dichromate prepared from chrome iron ore ?

Maharashtra board-2019

9. (a) Name two metals which can be refined by Van Arkel Method.
 (b) Match the items of Column I with items of Column II:

	Column I	Column II
(i)	Bauxite	(a) Zinc
(ii)	Malachite	(b) Iron
(iii)	Calmine	(c) Copper
(iv)	magnetite	(d) Aluminium
(e)		Lead

Kerala Board-2015

10. (a) What are "minerals" and "ores"? Differentiate between them.

Assam Board-2020

11. Define the terms :

(a) Minerals

(b) Ores

Haryana Board-2016

12. Froth floatation process

Assam Board-2019

13. Depressant in froth floatation process

Assam Board-2019

14. Name the main ore of iron.

Assam Board-2017

15. (a) How is 'cast iron' different from pig iron?

- (b) Name the common elements present in the anode mud in electrolytic refining of copper.
 Why are they so present?
 (c) Name one metal which refined by van Arkel method?

Assam Board-2012

16. Write four alloys of Aluminium with its names, composition and uses.

MP Board-2016

17. Write the preparation of potassium dichromate from iron chromite ore.

Nagaland Board-2020

Section-E : Long Answer

1. Why is it that only sulphide ores are concentrated by froth floatation processes? What is the role of depressants in the froth floatation process of dressing of ores?

Assam Board-2022

2. Give the name and formula of two main ores of Iron. Describe the method to obtain Cast Iron from one of its ore and give chemical reaction also.

Uttarakhand Board-2020

3. Explain the extraction of Zinc from its chief ore.

Tamil Nadu Board-2011

4. (a) Describe the preparation of potassium dichromate from chromite ore.
 (b) How does the acidified solution of potassium permanganate react with
 (i) Oxalic acid
 (ii) Iron (II) ions.

Manipur Board-2017

5. (a) Describe the step wise preparation of potassium dichromate from iron chromite ore. (Give balanced chemical equations)
 (b) What is the effect of increasing pH on a solution of potassium dichromate? Write chemical equation involved .

NIOS Board-2018

6. (a) Explain the following :
 (i) Al is used in the extraction of Cr from chromium oxide.
 (ii) Role of cryolite in the metallurgy of aluminium.
 (b) Account for the following :
 (i) HF is a liquid at room temperature whereas HCl is a gas.
 (ii) Amongst the noble gases only Xenon is known to form compounds.

NIOS Board-2015

7. Write any two ores of the following metals:

(a) Aluminium

(b) Zinc

(c) Iron

(d) Copper

Andhra Pradesh Board-2020

8. What is benefaction of the Ores? Explain froth floatation process.

Haryana Board-2017

9. Differentiate between minerals and ores.

Haryana Board-2017

10. Discuss froth floatation process for the concentration of ores.

Haryana Board-2018

C. Extraction of Crude Metal from Concentrated Ore

Section-A : Multiple Choice Questions

1. German silver is a mixture of which metals?

- (a) Germanium, Silver and Copper
- (b) Nickel, Silver and Copper
- (c) Zinc, Silver and Copper
- (d) Zinc, Nickel and Copper

Gujarat Board 2023 (March), 2018

Ans. (d)

2. Which substance is used as collector in forth floatation process?

- (a) phenol
- (b) aniline
- (c) fatty acid
- (d) cresol

Gujarat Board 2023 (March)

3. Which method is used for purification of Sn metal?

- (a) Zone refining
- (b) Liquation
- (c) Distillation
- (d) Vapour phase refining

Gujarat Board 2022 (July)

Ans. (b)

4. The pair of metals that can be purified by Van Arkel method is—

- (a) Na, Al
- (b) Ga, Zn
- (c) Ni, Si
- (d) Zr, Ti

Rajasthan Board 2022

Ans. (d)

5. The metal extracted by electrolytic reduction is

- (a) Ag
- (b) Cu
- (c) Al
- (d) Pb

ISC Board-2002

Ans. (c)

6. Mac Arthur-Forrest process is used for the extraction of

- (a) Aluminum
- (b) Copper
- (c) Silver
- (d) Tin

ISC Board-2005

Ans. (c)

7. The mineral that does not contain aluminum is

- (a) Bauxite
- (b) Fluorspar
- (c) Feldspar
- (d) Cryolite

ISC Board-2004

Ans. (b)

8. The process of removing impurity from a crude metal is called

- (a) Concentration
- (b) Calcination
- (c) Refining
- (d) Roasting

ISC Board-2004

Ans. (c)

9. Lanthanides are extracted from:

- (a) Limonite
- (b) Monazite
- (c) Magnetite
- (d) Cassiterite

Tamil Nadu Board-2016

Ans. (b)

10. Which is the Zinc ore?

- (a) Copper pyrite
- (b) Haematite
- (c) Bauxite
- (d) Calamine

Gujarat Board-2019

Ans. (d)

11. The method used for the concentration of sulphide ores is

- (a) Hydraulic washing
- (b) Leaching
- (c) Magnetic separation
- (d) Froth floatation

Kerala Board-2022

Ans. (d)

12. Iron pyrites is ore of :

- (a) Iron
- (b) Copper
- (c) Aluminium
- (d) Zinc

Haryana Board -2016

Ans. (a) :

13. Layer of which metal is applied on iron surface of galvanized iron?

- (a) Zn
- (b) Cu
- (c) Si
- (d) Ag

Gujarat Board-2016

Ans. (a)

14. Which of the following two substances react to produce blister copper?

- (a) $\text{Cu}_2\text{O}_{(s)}$ and $\text{FeS}_{(s)}$
- (b) $\text{Cu}_2\text{S}_{(s)}$ and $\text{O}_{2(g)}$
- (c) $\text{Cu}_2\text{S}_{(s)}$ and $\text{Cu}_2\text{O}_{(s)}$
- (d) $\text{Cu Cu}_2\text{S}_{(s)}$ and $\text{FeS}_{2(s)}$

Gujarat Board-2018

Ans.(c) :

15. Which reaction occurs in blast furnace at 1270 K temperature?

- | | |
|--|--|
| (a) $3\text{Fe}_3\text{O}_4 + \text{CO} \rightarrow$ | (b) $\text{Fe}_3\text{O}_4 + \text{CO}$ |
| (c) $\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow$ | (d) $\text{FeO} + \text{CO} \rightarrow$ |

Gujarat Board-2017

Ans. (d)

16. Which reaction occurs at more than 1200 K temperature in Blast furnace.

- (a) $\text{Fe}_2\text{O}_3 + \text{CO}_{(g)} \rightarrow 2\text{FeO} + \text{CO}_{2(g)}$
- (b) $\text{Fe}_3\text{O}_4 + \text{CO}_{(g)} \rightarrow 3\text{FeO} + \text{CO}_{2(g)}$
- (c) $3\text{Fe}_2\text{O}_3 + \text{CO}_{(g)} \rightarrow 2\text{Fe}_3\text{O}_4 + \text{CO}_{2(g)}$
- (d) $\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$

Gujarat Board-2018

Ans. (d)

17. Which metal can be purified by liquation?

- (a) Tin
- (b) Lead
- (c) Iron
- (d) Nickel

Gujarat Board-2019

Ans. (a)

18. Copper matte is a mixture of _____.

- (a) $\text{Cu}_2\text{O} + \text{FeO}$
- (b) $\text{Cu}_2\text{S} + \text{CuS}$
- (c) $\text{Cu}_2\text{O} + \text{Cu}_2\text{S}$
- (d) $\text{Cu}_2\text{S} + \text{FeS}$

Gujarat Board-2020

Ans : (d)

19. Magnetite is an ore of:

- (a) Iron
- (b) Calcium
- (c) Copper
- (d) Zinc

Haryana Board-2016

Ans. (a)

20. Which of the following processes is used for purification of nickel?

- (a) Zone refining
- (b) Mond's process
- (c) Van Arkel process
- (d) Froth floatation process

Jharkhand Board-2023

Ans. (b)

Section-B : Very Short Answer

1. (i) Describe the preparation of KmnO_4 from Pyrolusite ore.
(ii) What are alloys ? Give two examples.

Haryana Board 2023

2. In the extraction of Aluminium metal by Half-Heroult process.

(a) Write overall cell reaction.

(b) What is the role of Na_3AlF_6 ?

(c) On which electrode aluminium metal deposits.

Karnataka board 2023

3. Draw labeled diagram of fourth floatation process.

Rajasthan Board 2023

4. Write the role of

- (a) Dilute NaCN in the extraction of Gold.
- (b) CO in the extraction of Iron.

CBSE-2020

5. Write the role of the following :

- (i) NaAlF_4 in the extraction of Aluminium
- (ii) CO in the refining of Ni

CBSE-2020

6. Write the role of the following:

- (a) Silica in the extraction of copper
- (b) CO in the extraction of iron

CBSE-2020

7. Why does ZnO appear yellow on heating ?

CBSE-2019

8. (d) Give two points of differences between pig iron and cast iron

- (a) Outline the principle of zone refining

CBSE-2019

9. A crystalline solid 'A' burns in air to form a gas 'B' which turns lime water milky. The gas is also produced as a by-product during roasting of sulphide ore. This gas decolorises acidified KMnO_4 (aq.) solution and reduces Fe^{3+} to Fe^{2+} . Identify 'A' and 'B' and write the reactions involved.

CBSE-2019

10. (a) Give two points of differences between pig iron and cast iron.

- (b) Outline the principle of zone refining.

CBSE-2019

11. Write chemical reactions taking place in the extraction of Aluminium from Bauxite ore.

CBSE-2019

12. Name two important ore of silver. Describe the extraction of silver from these ores.

ISC Board-2002, 2009

41. How is copper extracted from copper matte?
Odisha Board-2023
42. What happens when conc. HNO_3 reacts with iron?
Odisha Board-2023
43. What is the function of limestone in the extraction of iron? Give equation to explain its action.
Odisha Board-2023
44. Iron scraps are advisable and advantageous than zinc scraps for reducing the low grade copper ores. Why?
Karnataka Board-2020
45. What is the role of depressant (NaCN) in Forth-Flotation method?
Karnataka Board-2019
46. Write the chemical equations involved in the self-reduction method for the extraction of copper from a copper ore.
NIOS Board-2012
47. Write down reactions involved in preparation of Potassium dichromate from chromite ore.
Punjab Board-2017
48. Give the various reactions which take place in the blast furnace during the extraction of iron.
J&K Board-2019
49. When copper is extracted from pyrite ore, the molten copper metal in the Bassemmer converter is contaminated with basic FeO impurity. Suggest a flux that can be used to remove the impurity as slag.
Manipur Board-2019
50. Illustrate how leaching technique is used for extraction of gold.
Manipur Board-2022
51. Explain the purification of Sulphide ore by froth floatation method.
Andhra Pradesh Board-2018
52. Draw a neat and labelled diagram of "blast furnace".
Rajasthan Board-2018
53. What is the role of Silica in the copper metallurgy?
Rajasthan Board-2018
54. What is the percentage composition and use of Nichrome?
Tamilnadu Board, Sep.-2016
55. Which form of the iron is the purest form of commercial iron?
Assam Board-2020
56. Name one important ore of aluminium. Give its chemical composition.
Assam Board-2018

- Section-C : Short Answer**
1. Assertion (A): Au and Ag are extracted by leaching their ores with a dil. solution of NaCN .
Reason (R): Impurities associated with these ores dissolve in NaCN .
 (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
 (d) Assertion (A) is incorrect, but Reason (R) is correct statement.
- CBSE-2020
- Ans. (c)**
2. Assertion (A): Nickel can be purified by the Mond process.
Reason (R): $\text{Ni}(\text{CO})_4$ is a volatile compound which decomposes at 460 K to give pure nickel.
 (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
 (d) Assertion (A) is incorrect, but Reason (R) is correct statement.
- CBSE-2020
- Ans. (a)**
3. What is the role of coke in the extraction of Zinc from Zinc oxide? Write the chemical equation.
- Karnataka board 2023
- Ans. 0**
- Section-D : Case Based Study**
1. Describe Hall-Heroult process for extraction of aluminium and draw the electrolytic cell used in the process.
Rajasthan Board 2022
2. Describe the zone refining process for purification of metals and draw its diagram.
Rajasthan Board 2022
3. (i) Write the role of 'CO' in the purification of nickel.
 (ii) What is the role of silica in the extraction of copper ?
 (iii) What type of metals are generally extracted by electrolytic method ?
- CBSE-2019

4. Write the principle of the following:
 (a) Hydraulic washing
 (b) Chromatography
 (c) Froth-floatation process
- CBSE-2019
5. (a) What is the difference between calamine and malachite?
 (b) Why is zinc used instead of Cu for recovery of Ag from $[Ag(CN)_2]^-$?
 (c) What is the role of cryolite in metallurgy of Al?
- CBSE-2019
6. In the extraction of zinc from zinc blende.
 (i) Give an equation to show how zinc oxide is converted to zinc?
 (ii) How is impure zinc finally electro-refined?
- ISC Board-2013
7. (i) The reaction,
 $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr, \Delta G^\circ = -421 \text{ kJ}$ is thermodynamically feasible as is apparent from the Gibbs energy value. Why does it not take place at room temperature?
 (ii) Write all the reactions involved in the extraction of aluminium from bauxite ore.
- Delhi 2008C
8. Describe how the following changes are brought about?
 (i) Pig iron into steel.
 (ii) Bauxite into pure alumina.
 (iii) Impure copper into pure copper.
- Foreign 2010
9. Give reasons for the following:
 (i) Alumina is dissolved in cryolite instead of being electrolysed directly.
 (ii) Zinc oxide can be reduced to the metal by heating with carbon but not Cr_2O_3 .
 (iii) Extraction of copper directly from sulphide ores is less favourable than that from its oxide ore through reduction.
- Delhi 2010; Delhi 2008
10. How can you obtain pure alumina from a bauxite ore associated with silica? Write the reactions involved in this process.
- All India 2011C
11. Describe how the following changes are brought about?
 (i) Pig iron into steel.
 (ii) Zinc oxide into metallic zinc.
 (iii) Impure titanium into pure titanium.
- Delhi 2010
12. Describe the role of
 (i) NaCN in the extraction of gold from gold ore.
- (ii) SiO_2 in the extraction of copper from copper matte.
 (iii) Iodine in the refining of zirconium. Write chemical equations for the involved reactions.
- Delhi 2010
13. Describe the role of the following:
 (i) NaCN in the extraction of silver from a silver ore.
 (ii) Iodine in the refining of titanium.
 (iii) Cryolite in the metallurgy of aluminium.
- All India 2010
14. Write down the reactions which occur in upper, middle and lower zones in the blast furnace during the extraction of iron from iron ore.
- Delhi 2011C
15. Write down the reactions taking place in different zones in the blast furnace during the extraction of iron. How is pig iron different from cast iron?
- Delhi 2015C
16. (a) Draw a labelled diagram of Blast furnace and write the name of any one metal for extraction of which this furnace is used.
- Uttarakhand Board-2020
17. Explain calcination and roasting with suitable examples.
- Telangana Board-2023
18. Discuss the principles of extraction of copper from its sulphide ores. How does it react with dil and conc. HNO_3 ? Give reactions.
- Odisha Board-2017
19. Write the equations involved in leaching of alumina from bauxite ore.
- Karnataka Board-2020
20. During the extraction of aluminium by Hall-Heroult process
 i) Write neat labeled diagram of electrolytic cell,
 ii) Write overall cell reaction,
 iii) At which electrode oxygen gas is liberated?
- Karnataka Board-2017
21. Explain the purification of sulphide ore by Froth Floatation Method.
- Andhra Pradesh Board-2019
- 22.(i) Match the items of Column I with items of Column II.
- | Column I | Column II |
|--------------|---------------|
| (i) Aluminum | (a) Malachite |
| (ii) iron | (b) Bauxite |
| (iii) Copper | (c) Limestone |
| (iv) Zinc | (d) Haematite |
| | (e) Calamine |
- (ii) The reduction of the metal oxide is easier if the metal formed is in liquid state, at the temperature of reduction. Give reason.
- Kerala Board-2013

23. Why is the extraction of copper from pyrites more difficult than that from its oxide ore through reduction ?
Haryana Board-2019
24. a) Explain the extraction of Zinc from Zinc Oxide (ZnO).
b) Mention the role of limestone in the extraction of Iron from haematite ore.
Karnataka Board-2020
25. With a neat labeled diagram, describe the extraction of aluminum by hall-hereoult process.
Karnataka Board-2016
26. a) Write the chemical resection involved in the extraction of gold using sodium cyanide.
b) Write the composition of copper matte.
Karnataka Board-2017
27. Write the chemical equation involved in van Arkel method for refining zirconium metal.
Maharashtra board-2018
28. Giving examples, differentiate between roasting and calcinations.
Jharkhand Board-2019
29. (i) Write chemical equations involved in the leaching of alumina from bauxite.
(ii) What is the purpose of adding cryolite or CaF_2 into purified Al_2O_3 during the extraction of Al ?
Kerala Board-2022
30. Give the general method used for the concentration of following ores:
(a) Bauxite ore
(b) Zinc sulphide ore
Kerala Board-2020
31. Explain gravity separation method for the concentration of ore.
Chhattisgarh Board-2020
32. What is the role of silica in the metallurgy of copper?
Jharkhand Board-2020
- 33.(a) Draw a labelled diagram of froth floatation method.
(b) Write any two differences between calcinations and roasting.
Rajasthan Board-2020
34. Draw a neat and labelled diagram of electrolytic cell for the extraction of aluminium.
Rajasthan Board-2017
35. Write the name of two metal which used in maximum composition in mischmetal.
Rajasthan Board-2017
36. Explain calcination and roasting with example.
Rajasthan Board-2015
37. Can we store $CuSO_4$ solution in an iron vessel ? Explain.
Rajasthan Board-2014
38. Draw labelled diagram of electrolytic cell for the extraction of aluminium and the overall reaction taking place in it.
Rajasthan Board-2014
39. Write the names of any two impurities present in bauxite ore.
Rajasthan Board-2013
40. Explain the method to remove iron impurity from matte with chemical equations. (Figure is not required).
Gujarat Board-2019
41. Give the Mond Process for refining of nickel.
Assam Board-2018
42. How is cast iron made from pgd iron?
Assam Board-2017
43. Mention the type of ore that can be concentrated by froth floatation process.
Assam Board-2017
44. Explain the role of the following in the processes mentioned:
(a) Silica in extraction of copper.
(b) Cryolite in the metallurgy of aluminum.
(c) Depressant in the froth floatation process
Assam Board-2012
45. Draw a labelled diagram of blast furnace for the extraction of Iron.
MP Board-2015
46. Draw the labelled diagram off vertical retort method used in extraction of zinc and write only equation of chemical reaction in the extraction of zinc from zinc blende.
MP Board-2014
47. a. How is zinc extracted from zinc blende? Give chemical reaction.
Nagaland Board-2018
48. Explain with neat diagram the extraction of aluminium from molten alumina.
Nagaland Board-2018
49. Why are metallic ores converted into oxide usually ?
(d) Discuss the process of leaching with reference to the extraction of aluminium.
Meghalaya Board-2018

Section-E : Long Answer

1. Describe concentration of ores on the basis of magnetic property. (Figure is not required)
Gujarat Board-2021
2. Illustrate calcinations method with equations.
Gujarat Board-2021
3. How is Zinc extracted from its chief ore?
Tamil Nadu Board-2015
4. Explain the extraction of zinc from its ore.
Tamil Nadu Board-2011
5. Describe the extraction of Lanthanides from monazite sand.
Tamil Nadu Board-2011
6. a) Explain the method of preparation of potassium dichromate from mineral chromite. Write chemical equations involved.
b) Explain the application of complexes in the extraction of metals. Write chemical equations involved.

NIOS Board-2021

D. Electrochemical Principles of Metallurgy

Section-A : Multiple Choice Questions

Ans. (a)

- 2. Which impurity is not present in bauxite?**

(a) Titanium oxide (b) Iron oxide
(c) Silicon oxide (d) Calcium oxide

Gujarat Borad-2022 (July)

Gujarat Board-2022 (July)

Ans. (d)

3. The name of metal nanoparticle which acts as highly effective bacterial disinfectant in water purification process is _____.
(a) carbon black
(b) silver
(c) gold
(d) copper

Maharashtra board-2022

Ans. (b)

Ans. (a)

5. In the metallurgy of iron from haematite, limestone is added to act as
(a) flux
(b) slag
(c) a reducing agent
(d) An oxidizing agent.

Manipur Board-2017

Ans. (a)

Gujarat Board-2019

Ans. (a)

Gujarat Board-2016

Ans. (d)

- 8. Which principle is involved in chromatographic method?**

(a) Thermodynamics (b) Leaching
(c) Separation (d) Adsorption

a) Adsorption

Ans (d)

Section-B : Very Short Answer

1. Differentiate between 'Roasting' and 'Calcination' with one example each.
Manipur Board 2020
 2. What is pyrometallurgy?
Manipur Board 2023
 3. Give an example of a metal which can be purified by the process of distillation.
 4. State briefly the principles involved in the following operations in metallurgy. Give one example for each
 - (a) Van Arkel Method
 - (b) Froth Floatation Process
CBSE-2020

CBSE-2019

Section-C : Short Answer

- | | | |
|-----|--|---------------------|
| 1. | Explain the role of the following: | |
| | (a) NaCN in the separation of ZnS and PbS. | |
| | (b) SiO ₂ in the metallurgy of Cu containing Fe as impurity. | |
| | (c) Iodine in the refining of Ti. | |
| | | CBSE-2020 |
| 2. | Write down the reactions taking place in blast furnace related to the metallurgy of iron in the temperature range 500 K – 800 K. What is the role of limestone in the metallurgy of iron ? | |
| | | CBSE-2019 |
| 3. | Copper pyrite is an ore of copper. | |
| | (i) Describe the process by which copper pyrite is concentrated. | |
| | (ii) Describe all the steps with equations, to convert the concentrated ore to blister copper. | |
| | (iii) Describe the process of conversion of blister copper to pure copper. | |
| | | ISC Board-2007 |
| | | Gujarat Board-2018 |
| 14. | Write Hume-Rothery rules for the formation of alloys. | Gujarat Board-2017 |
| 15. | Limestone in the metallurgy of iron. | Assam Board-2019 |
| 16. | Explain Zone refining. | J & K board-2023 |
| 17. | Write the steps and reactions involved in the manufacture of sulphuric acid by Contact process. | Nagaland Board-2018 |
| 18. | (a) What is meant by leaching? Give one example to illustrate the use of leaching in metallurgical process. | Nagaland Board-2017 |
| 19. | Explain with suitable diagram the production of blistered copper from copper matte by Bessemerization. | Nagaland Board-2017 |

Section-E : Long Answer

- Metals are extracted from their ores
 - Among the following which metal is extracted from bauxite:
 - Zinc
 - Iron
 - Aluminium
 - Copper
 - Sulphide ores are subjected to roasting while carbonate ores are subjected to calcinations. Comment on the statement.

Kerala Board-2016
 - Answer the following questions :
 - Write one point of difference between calcinations and roasting.
 - Draw a neat labelled diagram of an electrolytic cell used for the extraction of aluminium.

Goa Board-2019
 - Give both chemical equation of leaching of silver in silver metallurgy by using sodium cyanide.
- Rajasthan Board-2017

E. Oxidation and Reduction

Section-A : Multiple Choice Questions

- By which of the following reactions is blister copper obtained ?
 - $\text{Cu}^{2+} + \text{Zn} \rightarrow \text{Zn}^{2+} + \text{Cu}$
 - $\text{Cu}_2\text{S} + \text{FeS} \rightarrow 2 \text{Cu} + \text{FeS}_2$
 - $\text{Cu}_2\text{S} + 2 \text{Cu}_2\text{O} \rightarrow 6 \text{Cu} + \text{SO}_2$
 - $\text{Cu}_2\text{O} + \text{C} \rightarrow 2 \text{Cu} + \text{CO}$

CBSE-2020

Ans. (c)

- The oxidation of sodium sulphite by air is retarded by
 - MnO_2
 - H_2S
 - Alcohol
 - As_2O_3
- Tamil Nadu Board-2011

Ans. (c)

- Chemical reaction $\text{Zn} \rightarrow \text{Zn}^{2+} + 2e$ is an example of:
 - Oxidation process
 - Reduction process
 - Redox process
 - Reversible process
- Haryana Board-2016

Ans. (a)

- Process of rusting of iron is:
 - Oxidation
 - Reduction
 - Corrosion
 - Polymerization
- MP Board-2014

Ans. (c)

Section-B : Very Short Answer

- Write the balanced chemical equations involved in the preparation of KMnO_4 from pyrolusite ore (MnO_2).

CBSE-2020
 - Write the balanced ionic equations showing the oxidising action of acidified dichromate ($\text{Cr}_2\text{O}_7^{2-}$) solution with (i) Iron (II) Ion and (ii) tin (II) ion.

CBSE-2020
 - Write the products of the following reaction :

$$6 \text{XeF}_4 + 12 \text{H}_2\text{O} \rightarrow$$

 Is this reaction a disproportionation reaction ? Give reasons in support of your answer.

CBSE-2020
 - Out of zinc and tin, whose coating is better to protect iron objects ?

CBSE-2020
 - Give the equations for the conversion of argentite (Ag_2S) to metallic silver.

ISC Board-2004, 2012
 - How is chemical reduction different from electrolytic reduction? Name a metal of each which is obtained by
 - electrolytic reduction.
 - chemical reduction.

All India 2010C
 - Explain the role of
 - cryolite in the electrolytic reduction of alumina.
 - carbon monoxide in the purification of nickel.

Delhi 2009
 - The extraction of gold by leaching with NaCN , involves both oxidation and reduction. Justify giving chemical equations.

All India 2012C
- #### Section-C : Short Answer
- What chemical principle is involved in choosing a reducing agent for getting the metal from its oxide ore? Consider the metal oxides, Al_2O_3 and Fe_2O_3 , and justify the choice of reducing agent in each case.

HOTS; All India 2008
 - What are oxidation potential and reduction potential?

Jharkhand Board-2019
 - How is KMnO_4 prepared pyrolusite? Give one use of KMnO_4 .

Nagaland Board-2018
- #### Section-E : Long Answer
- (a) What is electrochemical series ? Write one of its application. Calculate the e.m.f of the cell $\text{Cr}|\text{Cr}^{3+}(0.1\text{M})||\text{Fe}^{2+}(0.01\text{M})|\text{Fe}$.

$$[\text{E}^{\circ}_{\text{Cr}}]_{\text{Cr}} = -0.75\text{V}$$
 and $\text{E}^{\circ}_{\text{Fe}}|_{\text{Fe}} = -0.45\text{V}$, $\log 10 = 1$.

Nagaland Board-2018
- 166

F. Refining

Section-A : Multiple Choice Questions

1. In the Mond's process the gas used for the refining of a metal is

 - (a) H₂
 - (b) CO₂
 - (c) CO
 - (d) N₂

CBSE-2020

Ans. (c)

CBSE-2020

Ans. (c)

Gujarat Board-2021

Ans. (d)

4. In Van Arkel method for refining zirconium or titanium, the halogen used is ____.

 - (a) fluorine
 - (b) chlorine
 - (c) bromine
 - (d) iodine

Maharashtra board-2019

Ans. (d)

5. Which method is used in the refining of Titanium metal?

 - (a) Mond carbonyl
 - (b) Frasch
 - (c) Zone refining
 - (d) Van Arkel

Gujarat Board-2018

Ans.(d) :

Gujarat Board-2017

Ans (d)

7. For obtaining high purity of tin metal, which refining process is useful?

 - (a) Distillation
 - (b) Mond Process
 - (c) Liquation
 - (d) Van Arkel Method

Gujarat Board-2020

Ans. (d)

8. Leaching is a process of
(a) reduction
(b) concentration
(c) refining
(d) oxidation

Jharkhand Board-2023

Ans. (b)

Section-B : Very Short Answer

- Explain the method for refining impure Copper
Gujarat Board 2023 (March)
 - Describe zone refining method. (Figure is not required)
Gujarat Board 2022 (July)
 - Name the method of refining used to obtain semiconductor of very high purity.
CBSE-2020
 - How is leaching carried out in the case of low grade copper ores ? Name the method used for refining of copper metal.
CBSE-2020
 - Name the method used for the refining of Zinc.
CBSE-2020
 - Write the principle of the following refining methods :
(a) vapour phase refining
(b) chromatography
CBSE-2020
 - Write the principle of the following refining methods :
(i) vapour phase refining
(ii) chromatography
CBSE-2020
 - Write the name and principle of the method used for refining of (a) Tin, (b) Copper, (c) Nickel.
CBSE-2019
 - Write the name and principle of the method used for refining of (a) Zinc, (b) Germanium, (c) Titanium.
CBSE-2019
 - State briefly the principles involved in the following operations in metallurgy. Give one example for each.
(a) Refining by Liquation
(b) Zone Refining
CBSE-2019
 - State the basis of refining a substance by chromatographic method. Under what circumstances is this method specially useful?
All India 2008C
 - Describe the underlying principle of each of the following metal refining methods:
(i) Electrolytic refining of metals.
(ii) Vapour phase refining of metals.
All India 2009
 - Describe the principle controlling each of the following processes.
(i) Vapour phase refining of titanium metal.
(ii) Froth floatation method of concentration of a sulphide ore.
All India 2011
 - Describe the principle controlling each of the following processes
(i) Zone refining of metals.
(ii) Electrolytic refining of metals.

15. Describe the principle involved in each of the following processes:
 (i) Mond's process for refining of nickel
 (ii) Column chromatography for purification of rare elements.
- Delhi 2012
16. (i) Give an example of zone refining of metals.
 (ii) What is the role of cryolite in the metallurgy of aluminium?
- Delhi 2013
17. Describe the underlying principle of each of the following processes:
 (i) Recovery of silver from the solution obtained by leaching silver ore with a solution of NaCN.
 (ii) Electrolytic refining of a crude metal.
- All India 2014C
18. Describe the principle involved in each of the following processes:
 (i) Zone refining of metals.
 (ii) Vapour phase refining of metals.
- Delhi 2014;
all India 2013,2014; Foreign 2009
19. Describe underlying principles of the following processes:
 (i) Froth floatation process of concentration of ores.
 (ii) Vapour phase refining of metals.
- Delhi 2014C
20. Write the role of the following:
 (i) Iodine in the refining of zirconium.
 (ii) Silica in the extraction of copper from copper matte.
- Foreign 2014
21. Outline the principles behind the refining of metals by the following methods:
 (i) Zone refining method.
 (ii) Chromatographic method.
- All India 2014
22. Explain the principle of the method of electrolytic refining of metals. Give one example.
- All India 2014; Delhi 2014
23. Name the methods used for the vapour phase refining of impure titanium and nickel metals.
- Delhi 2013C
24. On what principle is the method of zone-refining of metals based?
- Foreign 2014
25. Name the method used for refining of copper metal.
- All India 2014; Delhi 2014; All India 2013
26. Explain Mond carbonyl process to refine Nickel metal.
- Gujarat Board-2016
27. Name a metal refined by Van Arkel method.
- Karnataka Board-2018
28. Which metal is refined by Van -Arkel method?
- Karnataka Board-2015
29. Write the principle involved in zone refining.
- Karnataka Board-2016
30. Name the method of refining of silicon.
- Karnataka Board-2017
31. Given the principle involved in zone refining process.
- Karnataka Board-2018
32. Spelter (impure zinc) contains Pb, Fe and Cd as impurities. How can you refine the impure zinc ?
- Manipur Board-2019
33. There are several methods for refining metals. Explain a method for refining Zirconium.
- Kerala Board-2016
34. Zone refining
- Assam Board-2019

Section-C : Short Answer

1. Explain the role of the following:
 (a) CO in the refining of Ni
 (b) Limes tone in the metallurgy of Fe
 (c) Depressant in the froth floatation method.
- CBSE-2020
2. (a) Name the method of refining which is
 (i) used to obtain semiconductor of high purity,
 (ii) used to obtain low boiling metal.
 (b) Write chemical reactions taking place in the extraction of copper from Cu₂S.
- CBSE-2019
3. Describe the role of the following:
 (i) Depressant in froth floatation process.
 (ii) Silica in the extraction of copper from copper pyrites ore.
 (iii) Cryolite in the metallurgy of aluminium.
- Delhi 2008C
4. Explain the basic principles of following metallurgical operations:
 (i) Zone refining
 (ii) Electrolytic refining
 (iii) Electrolytic refining
- Delhi 2008; foreign 2008
5. State briefly the principles which serve as basis for the following operations in metallurgy.
 (i) Forth floatation process
 (ii) Zone refining
 (iii) Refining by liquation
- Delhi 2008; Foreign 2008
6. Describe the principle involved in each of the following processes of metallurgy:
 (i) Froth floatation method.
 (ii) Electrolytic refining of metals.
 (iii) Zone-refining of metals.
- All India 2010
7. State the principles of the following methods of refining crude metals:
 (i) Zone refining
 (ii) Liquation method
 (iii) Chromatographic method.
- All India 2011C

8. Describe the principle behind each of the following processes:
- Vapour phase refining of a metal.
 - Electrolytic refining of a metal.
 - Recovery of silver after silver ore was leached with NaCN.
- Delhi 2011; Foreign 2011
9. Explain the role of each of the following in the extraction of metals from their ores:
- CO in the extraction of nickel.
 - Zinc in the extraction of silver.
 - Silica in the extraction of copper.
- Delhi 2011
10. Write the reactions involved in the following processes:
- Leaching of bauxite ore to prepare pure alumina.
 - Refining of zirconium by van-Arkel method.
 - Recovery of gold after gold ore has been leached with NaCN solution.
- Foreign 2011
11. State the role of
- depressant in froth floatation process.
 - silica in the metallurgy of copper.
 - graphite rod in the electrolytic reduction of alumina.
- Delhi 2011C
12. Write the principle behind the froth floating process. What is the role of collectors in this process?
- All India 2014
13. Write the principles of the following methods:
- Vapour phase refining
 - Zone-refining
 - Chromatography
- Delhi 2017
14. (i) Write the principle of electrolytic refining.
(ii) Why does copper obtained in the extraction from copper pyrites have a blistered appearance?
(iii) What is the role of depressants in the Froth floatation process?
- All India 2017
15. (i) Write the principle of method used for the refining of germanium.
- (ii) Out of PbS and PbCO₃ (ores of lead), which one is concentrated by froth floatation process preferably?
(iii) What is the significance of leaching in the extraction of aluminium?
- Delhi 2017
16. (i) Name the method of refining of nickel.
(ii) What is the role of cryolite in the extraction of aluminium?
(iii) What is the role of limestone in the extraction of iron from its oxides?
- All India 2015
17. (i) Name the method of refining of metals such as germanium.
(ii) In the extraction of Al, impure Al₂O₃ is dissolved in conc. NaOH to form sodium aluminate and leaving behind impurities. What is the name of this process?
(iii) What is the role of coke in the extraction of iron from its oxides?
- All India 2015
18. (i) Name the method of refining to obtain silicon of high purity.
(ii) What is the role of SiO₂ in the extraction of copper?
(iii) What is the role of depressants in froth floatation process?
- All India 2015
19. (i) Indicate the principle behind the method used for the refining of zinc.
(ii) What is the role of silica in the extraction of copper?
(iii) Which form of the iron is the purest form of commercial iron?
- Delhi 2015
20. Answer the following:
- What is the role of cryolite in the metallurgy of aluminium?
 - Differentiate between roasting and calcination.
 - What is meant by the term ‘chromatography’?
- All India 2015C
21. Outline the principles of refining of metals by the following methods.
- Distillation
 - Zone refining
 - Electrolysis
- Delhi 2015C

		Section-E : Long Answer
22.	(i) Indicate the principle behind the method used for the refining of nickel. (ii) What is the role of dilute NaCN in the extraction of gold? (iii) What is 'copper matte'?	1. Outline the principles of refining of metals by the following methods : (a) Zone refining (b) Poling
	Foreign 2015	Telangana Board-2017
23.	a) In the extraction of Aluminium by electrolysis. i) Write overall cell reaction. ii) What is the role of cryolite? b) Name the metal refined by Mond's process.	2. State the principle of zone refining method and which metal can be refined by this method.
	Karnataka Board-2019	Gujarat Board-2019
24.	Explain the steps involved in the vapour phase refining of Ni and Zr	3. Draw a neat labelled diagram of Froth floatation process used for the concentration of sulphide ores. State the principle behind (a) zone refining (b) chromatographic methods, used for refining elements.
	Kerala Board-2019	Goa Board-2018
25.	Describe a method of refining nickel.	4. Explain the Van-Arkel-Method for refining of metals.
	Assam Board-2014	Haryana Board-2018
26.	Describe the following: (a) Zone refining (b) Electrolytic refining	5. Explain Zone refining method for refining of metals.
	Haryana Board-2016	Haryana Board-2018
27.	Draw a neat labelled diagram of the zone refining method used for purification of elements. Name the electrolytic process used in the extraction of Aluminium from purified Al_2O_3 .	6. Draw a neat and labelled diagram of zone refining process.
	Goa Board-2019	Rajasthan Board-2017
28.	Give both chemical equation of 'Mond process' used in nickel refining.	7. How copper is refined with electrolytic method? Explain with necessary reaction?
	Rajasthan Board-2017	Rajasthan Board-2016
29.	Write the chemical reactions related to Mond process for refining nickel metal	8. Draw labelled diagram of Zone refining process. In which this process is useful ?
	Rajasthan Board-2013	Rajasthan Board-2014
30.	Explain zone-refining (figure not necessary).	9. Explain Zone Refining method to refined metal (figure not required).
	Gujarat Board-2017	Gujarat Board-2018
31.	Distinguish between calcination and roasting.	10. Explain the liquation process of refining.
	Assam Board-2015	Haryana Board-2016
32.a.	Explain zone refining method for the purification of metals. Or b. Explain calcinations and roasting with examples.	11. Either (a) What are the two requirements for vapour phase refining? Write the chemical reactions which occur during Monds process for the refining of nickel.
	Nagaland Board-2020	Meghalaya Board-2019
33.	(a) What is the principle of zone refining ? (b) What is flux ? Give one example each of an acidic flux and a basic flux.	12. What is the role of cryolite in the metallurgy of aluminium? (c) Name the depressant used for the separation of ZnS ore from PbS ore during froth floatation process. (d) How would you convert pig iron into cast iron?
	Meghalaya Board-2018	Meghalaya Board-2019

P-Block Elements

A. Boron Family (Group 13-Elements)

Section-A : Multiple Choice Questions

1. On moving down the group, the radius of an ion:
- (a) Decreases
 - (b) Increases
 - (c) No change
 - (d) None of these

Tamil Nadu Board-2015

Ans. (b)

2. Which one of the following is not a nucleophile?
- (a) H_2O
 - (b) CN^-
 - (c) NH_3^-
 - (d) BF_3

NIOS Board-2018

Ans. (d)

3. Which of the following is not a Lewis Acid?
- (a) SnCl_4
 - (b) AlCl_3
 - (c) BF_3
 - (d) BaCl_2

NIOS Board-2021

Ans. (d)

4. How burnt alum is obtained?

Tamil Nadu Board-2016

Ans. (0)

5. The metal which exists as a liquid at room temperature is:
- (a) Germanium
 - (b) Indium
 - (c) Gallium
 - (d) Thallium

Tamil Nadu Board-2016

Ans. (c)

6. The electron affinity of an atom is:
- (a) directly proportional to its size
 - (b) inversely proportional to its size
 - (c) is independent of its size
 - (d) none of these

Tamil Nadu Board-2016

Ans. (b)

7. Common impurities present in Bauxite ore:
- (a) CuO
 - (b) ZnO
 - (c) Fe_2O_3
 - (d) None of these

Haryana Board-2017

Ans. (c)

8. Smelting involves reduction of metal oxide with:
- (a) Carbon
 - (b) CO
 - (c) Mg
 - (d) Al

Haryana Board -2016

Ans. (a)

9. In which of the following minerals Aluminium is not present?
- (a) Cryolite
 - (b) Mica
 - (c) Feldspar
 - (d) Fluorspar

Haryana Board -2016

Haryana Board-2017

Ans. (d)

10. Electron affinity is expressed in:
- (a) Kilojoule
 - (b) joule
 - (c) kilojoule mol
 - (d) kilojoule mol^{-1}

Tamilnadu Board, March-2016

Ans. (d)

11. By which of the following, poisoning of lead in the body can be removed?
- (a) Ptn
 - (b) EDTA
 - (c) OX^{2-}
 - (d) Pn

Gujarat Board-2017

Ans.(b)

12. In Hall-Heroult process for preparation of Aluminium from Al_2O_3 , why Na_3AlF_6 is added.
- (a) To reduce melting points of Al_2O_3
 - (b) To protect graphite rod present on anode
 - (c) To reduce rate of reaction of Al_2O_3
 - (d) To obtain Extra Pure Aluminium Metal

Gujarat Board-2020

Ans. (a)

Section-B : Very Short Answer

1. Define hybridisation
Tamil Nadu Board-2018
2. How is Potash Alum prepared?
Tamilnadu Board, Sep.-2016
3. What is bond order?
Tamilnadu Board, March-2016
4. Which metal foils are used for wrapping chocolates?
Assam Board-2015

Section-C : Short Answer

1. Why does the first element in each group of p-block show anomalous behaviour? Give examples of two such properties in which this behaviour is shown.

NIOS Board-2015

2. Briefly explain aluminothermic process.

Tamil Nadu Board-2016

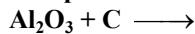
3. The value of covalent bond length of Si-C is 1.93 \AA . Covalent radius of carbon atom is 0.77 \AA . Calculate the covalent radius of silicon atom.

Tamil Nadu Board-2018

4. What is the role of cryolite in the metallurgy of aluminium?

Andhra Pradesh Board-2020

5. Complete the following reaction:



Assam Board-2014

6. Name two important ores of Aluminium.

Haryana Board -2016

7. (i) Give two important uses of Al & Zn

- (ii) Explain vapour phase refining.

Haryana Board-2016

8. Explain the role of:

- (a) Cryolite in the electrolytic reduction of alumina

- (b) Carbon monoxide in the purification of nickel.

Haryana Board-2018

9. (a) Describe the factors influencing the ionization energy.

Tamilnadu Board, Sep.-2016

10. Al_2O_3 is amphoteric in nature, mention it by chemical equation.

Gujarat Board-2019

11. Explain the following observations : (any three)

- (i) Sky appears blue in colour.

- (ii) Deltas are formed where river meets the sea.

- (iii) Alum ferric chloride solution is applied to stop bleeding.

- (iv) Mist or fog is formed in winter.

Assam Board-2017

12. (a) Explain the role of Na_3AlF_6 in the electrolytic reduction of alumina.

Assam Board-2016

13. Write names, formula and uses of following compounds:

- (i) Hematite

- (ii) Silver Glans

- (iii) Luner-Caustic

- (iv) Corrosive Sublimate

MP Board-2016

Section-E : Long Answer

1. (a) Although B—F bond in BF_3 is polar but the dipole moment of BF_3 is zero, why?

- (b) Write down the Fajans' rules which increase covalent character of an ionic bond.

- (c) Draw the molecular orbital diagram of He_2 molecule. Calculate its bond order. Is it stable?

NIOS Board-2018

2. Explain Aluminothermic process with neat diagram.

Tamilnadu Board, Sep.-2016

3. Write the concentration of Bauxite ore by Hall's process with equation.

MP Board-2018

4. Describe with diagram the Siemens Martin process of manufacturing of steel.

MP Board-2018

5. Write the reaction taking place in blast furnace when haematite is converted into pig iron with diagram.

MP Board-2017

B. Carbon Family (Group 14-Elements)**Section-A : Multiple Choice Questions**

1. Conjugate base of HCO_3^- is :

- (a) H_2CO_3 (b) CO_3^{2-}
(c) CO_2 (d) H_2O

Chhattisgarh Board-2023

Ans. (b)

2. Which has maximum dipolemoment?

- (a) CH_2Cl_2 (b) CHCl_3
(c) CCl_4 (d) CO_2

Haryana Board-2016

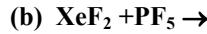
Ans. (a)

Section-B : Very Short Answer

1. A translucent white waxy solid (A) on heating in an inert atmosphere is converted to its allotropic form (B). Allotrope (A) on reaction with dilute aqueous KOH liberates a highly poisonous gas (C) having rotten fish smell. With excess of chlorine (A) forms (D) which hydrolyses to compound (E). Identify the compounds A to E.

CBSE-2019

2. Complete and balance the following equations :



CBSE-2019

3. Write balanced chemical equations involved in the following reactions :
 (a) Fluorine gas reacts with water.
 (b) Phosphine gas is absorbed in copper sulphate solution.
- CBSE-2019
4. Complete the following chemical equation:
 $\text{SiO}_2(\text{g}) + \text{HF}(\text{g}) \rightarrow$
- Foreign 2010
5. Give reason for the following:
 PbCl_4 is more covalent than PbCl_2 .
- All India 2013
6. Complete the following equation:
 $\text{C} + \text{H}_2\text{SO}_4(\text{conc.}) \rightarrow$
- Delhi 2011; foreign 2011
7. $\text{Pb}(\text{NO}_3)_2$ on heating gives a brown gas which undergoes dimerisation on cooling? Identify the gas.
- All India 2016
8. How is silicon tetrachloride formed? What happens when it reacts with water? Write chemical equations involved.
- NIOS Board-2021
9. What type of semiconductor formed when Si is doped with P?
- Haryana Board-2022
10. In the first transition series of elements, which element shows highest oxidation state?
- Assam Board-2015

Section-C : Short Answer

1. Account for the following :
 (a) Graphite rods in the extraction of Aluminium from Al_2O_3 have to be replaced from time to time.
 (b) It is advantageous to roast sulphide ore to oxide before reduction.
 (c) The reduction of the metal oxide is easier if the metal formed is in liquid state at the temperature of reduction.
- CBSE-2019
2. (a) Write the properties of ionic crystals.
- Tamil Nadu Board-2011
3. What are p-block elements ? How many groups in the modern periodic table constitute p-block ? Give two important roles that the elements nitrogen, oxygen and carbon play in our daily lives.
- NIOS Board-2022
4. Describe the two main types of semi-conductors and contrast their conduction mechanism.
- Andhra Pradesh Board-2019
5. Explain Siemens- Martin's open hearth process for the manufacture of steel with diagram.
- MP Board-2013

Section-E : Long Answer

1. (a) How are bonding and antibonding molecular orbitals formed from a given pair of atomic orbitals ? Compare these molecular orbitals with each other in terms of their energy.
 (b) Explain the following on the basis of valence bond theory
 (i) BCl_3 is planar but NH_3 is pyramidal.
 (ii) Both CCl_4 and SiCl_4 are tetrahedral.
- NIOS Board-2019
2. (a) Although C – O band is polar but CO_2 has zero dipole moment why?
 (b) According to VSEPR model what is the expected shape of molecules and arrangement of electron pairs of AX_3 and AX_6 type of molecules.
 (c) Name the factors which increase the covalent character of an ionic bond.
- NIOS Board-2019
3. Give the principle involved in the manufacture of nitric acid by Ostwald process. How does concentrated HNO_3 react with (i) C and (ii) I_2 ?
 OR
 How does white phosphorus react with (i) H_2SO_4 , (ii) sulphur, (iii) Mg, (iv) Na and (v) HNO_3 ?
- Jharkhand Board-2019

C. Allotropes of Carbon

Section-A : Multiple Choice Questions

1. Write any three uses of lead.
- Tamil Nadu Board-2016
- Ans. (a)**
2. What is philosopher's wool?
- Tamil Nadu Board-2016
- Ans. (0)**

Section-B : Very Short Answer

1. Which type of semiconductor is formed when Arsenic is doped with Germanium?
- Rajasthan Board-2018

Section-C : Short Answer

1. Write short notes on the following :
 (a) Clemmensen reduction
 (b) Wurtz reduction
 (c) Hell-Volhard-Zelinsky reaction
- Jharkhand Board-2020
2. (a) Why are Aryl halides less reactive toward nucleophilic substitution reactions than alkyl halides? Explain.

- (a) NO_2
(c) NO_3^-

- (b) NO^-
(d) N_2O

Gujarat Board-2019

Ans. (c)

15. The explanation for the presence of three unpaired electrons in the nitrogen atom can be given by

- (a) Pauli's exclusion principle
(b) Hund's rule
(c) Aufbau principle
(d) Heisenberg's uncertainty principle

NIOS Board-2023

Ans. (b)

16. Which is most Basic?

- (a) PH_3
(c) NH_3
(b) SbH_3
(d) AsH_3

Haryana Board-2022

Ans. (c)

17. Haber's process is used to prepare:

- (a) H_2SO_4
(c) HCl
(b) NH_3
(d) O_3

Haryana Board-2022

Ans. (b)

18. In the following strongest reducing agent is :

- (a) PH_3
(b) BiH_3
(c) SbH_3
(d) AsH_3

Haryana Board-2021

Ans. (b)

19. The oxidation state of nitrogen in dinitrogen trioxide is_____.

- (a) + 1
(c) + 3
(b) + 2
(d) + 4

Maharashtra board-2018

Ans. (c)

20. The conjugate acid of HPO_4^{2-} is:

- (a) H_3PO_3
(c) $\text{H}_2\text{P}\overset{\text{+}}{\text{O}}_4$
(b) H_3PO_4
(d) PO_4^{3-}

ISC Board-2017

Ans. (c)

21. The product obtained by the reaction of calcium phosphide with water is

- (a) Phosphoric acid
(b) Phosphine
(c) Phosphorous acid
(d) Phosphorus trichloride

Kerala Board-2020

Ans. (b)

- (a) NO_2
(c) NO_3^-

- (b) NO^-
(d) N_2O

Gujarat Board-2019

22. Maximum covalency of Nitrogen is:

- (a) 3
(c) 4
(b) 5
(d) 6

Haryana Board-2017

Ans. (c)

23. The percentage of π -character in the orbital forming p-p bonds in P_4 is:

- (a) 25
(c) 50
(b) 33
(d) 75

Haryana Board-2017

Ans. (d)

24. Which of the following element does not show allotropy?

- (a) Nitrogen
(c) Antimony
(b) Bismuth
(d) Arsenic

Haryana Board-2017

Ans. (b)

25. Hybridization in PH_3 is:

- (a) sp^3
(c) d^2sp^3
(b) sp^3d
(d) sp^3d^2

Haryana Board -2016

Ans. (a)

26. Which of following is monobasic ?

- (a) H_3PO_2
(c) HPO_3
(b) $\text{H}_4\text{P}_2\text{O}_6$
(d) H_3PO_5

Haryana Board -2016

Ans. (a)

27. Hybridization involved in PCl_5 is :

- (a) sp^3
(c) d^2sp^3
(b) sp^3d
(d) sp^2

Haryana Board-2016

Ans. (b)

28. In the following which is dibasic acid?

- (a) H_3PO_4
(c) H_3PO_2
(b) H_3PO_3
(d) HClO_4

Haryana Board-2018

Ans. (b)

29. The compound with garlic taste is:

- (a) P_2O_3
(c) H_3PO_3
(b) P_2O_5
(d) H_3PO_4

Tamilnadu Board, Sep.-2016

Ans. (a)

30. The migration of colloidal particles under the influence of an electric field is known as:

- (a) electro osmosis
(c) electrolysis
(b) cataphoresis
(d) ultrafiltration

Tamilnadu Board, March-2016

Ans. (c)

31. The sol, used in eye lotion is:

- (a) Silver solution
- (b) Colloidal Magnesium
- (c) Colloidal gold
- (d) Colloidal antimony

Tamilnadu Board, March-2016

Ans. (a)

32. Which of the following is the correct order of basicity of hydride compounds.

- (a) $\text{PH}_3 < \text{AsH}_3 < \text{NH}_3 < \text{SbH}_3$
- (b) $\text{SbH}_3 < \text{AsH}_3 < \text{PH}_3 < \text{NH}_3$
- (c) $\text{NH}_3 < \text{PH}_3 < \text{AsH}_3 < \text{SbH}_3$
- (d) $\text{SbH}_3 < \text{PH}_3 < \text{AsH}_3 < \text{NH}_3$

Gujarat Board-2018

Ans.(b) :

33. Presence of which of the following ion can be detected using ring test?

- (a) NO^-
- (b) NO_3^-
- (c) Cl^-
- (d) PO_4^{3-}

Gujarat Board-2017

Ans.(b)

34. Which explosive substance is obtained, when proportion of dichlorine gas is more in the reaction of dichlorine gas with ammonia gas?

- (a) Nitrogen(II) oxide
- (b) Nitrogen trichloride
- (c) Ammonium chloride
- (d) Ammonium chloride and Dinitrogen gas

Gujarat Board-2019

Ans. (b)

35. Oxidizing property is highest of:

- (a) I_2
- (b) Br_2
- (c) F_2
- (d) Cl_2

MP Board-2014

Ans. (c)

36. Which of the following does not exist?

- (a) PCl_5
- (b) NCl_5
- (c) AsCl_5
- (d) SbCl_5

Jharkhand Board-2023

Ans. (b)

37. Process of commercial production of nitric acid is

- (a) Haber process
- (b) Ostwald's process
- (c) Contact process
- (d) Deacon's process

Jharkhand Board-2023

Ans. (b)

38. Which of the following acids is a tribasic acid?

- (a) H_3PO_3
- (b) H_3PO_2
- (c) HPO_3
- (d) H_3PO_4

Jharkhand Board-2023

Ans. (d)

Section-B : Very Short Answer

1. Draw the structures of orthophosphorous acid, pyrosulphuric acid and chloric acid.

Gujarat Borad-2022 (July)

2. With reaction conditions, write the balanced chemical equations for the manufacture of nitric acid by Ostwald's process.

Karnataka board 2023

3. How PCl_3 prepared? What shape does it adopt?

Manipur Board 2023

4. Describe the manufacture of ammonia by Haber's process.

Manipur Board 2023

5. Describe Haber's process for the manufacture of Ammonia with diagram and write the chemical reactions involved during the process.

Uttarakhand Board 2023

6. (a) Draw the structure of an oxide of nitrogen where the oxidation state of nitrogen is + 5.

(b) With the help of a balanced chemical equation, suggest what happens when white phosphorus reacts with NaOH solution in an inert atmosphere.

CBSE-2019

7. (a) The bottle of liquid ammonia is cooled before opening the seal.

(b) Aquatic species are more comfortable in cold water than in warm water.

CBSE-2019

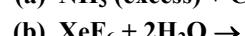
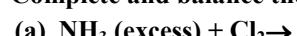
8. What is the basicity of H_3PO_3 ?

CBSE-2019

9. Name the molecular geometry of XeF_4 .

CBSE-2019

10. Complete and balance the following equations :



CBSE-2019

11. Aqua-regia is a mixture of and in the ratio of 3:1 .

ISC Board-2013

12. Give the balanced chemical equation:
Phosphorus reacts with concentrated sulphuric acid.

ISC Board-2016

13. (i) Draw the structures of the following molecules.



(ii) Write the structural difference between white phosphorus and red phosphorus.

All India 2014

14. Complete the following chemical equations:
 (i) $P_4 + SOCl_2 \rightarrow$
 (ii) F_2 (Excess) + $Cl_2 \xrightarrow{300^\circ C}$
- All India 2014C
15. Complete the following chemical equation:
 $Ca_3P_2(s) + H_2O(l) \rightarrow$
- Delhi 2008
16. Why is the bond angle in PH_3 is lesser than that in NH_3 molecule?
- All India 2008
17. Ammonia has greater affinity for protons than phosphine (PH_3). Explain with reason.
- All India 2008
18. What happens when white phosphorus is heated with conc. $NaOH$ solution in an inert gas atmosphere?
- All India 2008C
19. What happens when
 (i) $(NH_4)_2Cr_2O_7$ is heated?
 (ii) H_3PO_3 is heated?
 Write the equations.
- Delhi 2017
20. Explain the following:
 (i) Nitrogen is much less reactive than phosphorus.
 (ii) NF_3 is an exothermic compound but NCl_3 is an endothermic compound.
- All India 2015C
21. Give reason for the following:
 (i) Why does $R_3P = O$ exist but $R_3N = O$ does not? (where, R is an alkyl group)
 (ii) At room temperature, N_2 is much less reactive.
- All India 2013
22. What happens when
 (i) PCl_5 is heated? (ii) H_3PO_3 is heated?
 Write the reactions involved.
- Delhi 2013
23. (i) PH_3 has lower boiling point than NH_3 . Why?
 (ii) Write balance equation, when ammonia is dissolved in water.
- Delhi 2013
24. Explain the following:
 (i) NO_2 readily forms a dimer.
 (ii) $BiCl_3$ is more stable than PCl_5 .
- Delhi 2013C
25. Explain the following observations:
 (i) The molecules NH_3 and NF_3 have dipole moments which are of opposite direction.
 (ii) All the bonds in PCl_5 molecule are not equivalent.
- Delhi 2012
26. Draw the structures of white phosphorus and red phosphorus. Which one of these two types of phosphorus is more reactive and why?
- Delhi 2010
27. Account for the following:
 (i) H_3PO_2 has reducing nature.
 (ii) Phosphorus shows high tendency for catenation.
 (iii) Nitrogen found in gaseous state.
- Delhi 2013C
28. Explain each of the following:
 (i) Nitrogen is much less reactive than phosphorus.
 (ii) The stability of + 5 oxidation state decreases down the group 15.
 (iii) The bond angles ($O-N-O$) are not of the same value in NO_2^- and NO_2^+ .
- Delhi 2012
29. Mention optimum conditions for the industrial manufacture of ammonia by Haber's process.
- Foreign 2011; All India 2008
30. Red phosphorus is less reactive than white phosphorus. Why?
- Foreign 2011
31. Draw the structures of NF_3 and H_3PO_3 molecules.
- Foreign 2011
32. Nitrogen does not form pentahalides, although it exhibits + 5 oxidation state. Explain.
- All India 2011C; 2009; Delhi 2010; 2008C
33. Ammonia is more basic than phosphine. Why?
- All India 2011; Delhi 2010, 2009, 2008
34. NH_3 acts as a good ligand. Why?
- Delhi 2011C
35. Account for the following
 PCl_5 can act as an oxidizing agent but not as a reducing agent.
- All India 2011C
36. $BiCl_3$ is less covalent than PCl_5 . Explain.
- Delhi 2011C
37. What happens when H_3PO_3 (orthophosphorous acid) is heated?
- All India 2011C
38. Write chemical equation for the following process. orthophosphorous acid is heated.
- Delhi 2011C
39. The stability of + 5 oxidation state decreases down the group in group 15 of the periodic table. Explain why?
- Delhi 2010; foreign 2009
40. Solid phosphorus pentachloride behaves as an ionic compound. Explain why?
- Delhi 2010, 2009C, 2010C

41. Give reason: In the solid state, PCl_5 behaves as an ionic species. Delhi 2009C
42. Draw the structure of $\text{H}_4\text{P}_2\text{O}_7$. Delhi 2010
43. The stability of + 3 state increases down the group in group 15 of the periodic table. Explain why? Foreign 2010
44. Complete the following chemical reaction equation:

$$\text{AgCl(s)} + \text{NH}_3(\text{aq}) \longrightarrow$$
 Foreign 2010
45. What is the oxidation number of phosphorus in H_3PO_2 molecule? Delhi 2010
46. Draw the structure and predict the shape of H_3PO_3 . Delhi 2010C
47. N_2 is not particularly reactive. Explain. Delhi 2010C
48. Why is BiH_3 the strongest reducing agent amongst all the hydrides of group 15 elements? All India 2010, All India 2010C
49. In the structure of HNO_3 molecule, the N—O bond (121 pm) is shorter than N—OH bond (140 pm). explain. Delhi 2009; all India 2009
50. Ammonia has higher boiling point than phosphine. Explain why? All India 2009
51. Bi(V) is a stronger oxidising agent than Sb(V). Explain. All India 2009, 2008
52. Complete the following reaction equation:

$$\text{PCl}_5 + \text{H}_2\text{O} \text{ (excess)} \longrightarrow$$
 Foreign 2009
53. The basic character of the hydrides of group 15 elements decreases with increasing atomic numbers. Why? All India 2009
54. Complete the following reaction:

$$\text{NH}_3 + \text{NaOCl} \longrightarrow$$
 All India 2009
55. Phosphorus has greater tendency for catenation than nitrogen. Why? All India 2012
56. Nitrogen shows weaker tendency for catenation than phosphorus. Explain. All India 2010C, 2009; Foreign 2009
57. What is the basicity of H_3PO_2 and why? All India 2012
58. Complete the following chemical equation

$$\text{HgCl}_2 + \text{PH}_3 \longrightarrow$$
 Foreign 2012, 2011, 2010, 2009;
All India 2011, 2009
59. Complete the following chemical equation

$$\text{NH}_4\text{Cl(aq)} + \text{NaNO}_2(\text{aq}) \longrightarrow$$
 Foreign 2012
60. Give reason: Nitric oxide becomes brown when released in air. All India 2012C
61. The N—O bond in NO_2^- is shorter than the N—O bond in NO_3^- . Explain. Delhi 2011; All India 2011
62. All the P—Cl bonds in PCl_5 molecule are not equivalent. Explain why? Delhi 2011; All India 2009
63. Complete the following chemical equation:

$$\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \longrightarrow$$
 OR

$$\text{P}_4 + \text{SO}_2\text{Cl}_2 \longrightarrow$$
 Delhi 2011, 2010, 2009;
foreign 2011, 2010 2009
64. Tendency to form pentahalides decreases down the group in group 15 of the periodic table. Why? Delhi 2011
65. What is the basicity of H_3PO_4 ? Delhi 2015
66. Why does NH_3 act as Lewis base? All India 2014
67. Why does NO_2 dimerise? All India 2014, 2008; Delhi 2010
68. Why is the single N—N bond weaker than the single P—P bond? Foreign 2014
69. Arrange the following in the increasing order of their basic character:

$$\text{NH}_3, \text{PH}_3, \text{AsH}_3, \text{SbH}_3, \text{BiH}_3$$
 Foreign 2014
70. Arrange the following in order of the increasing basic strength:

$$\text{PH}_3, \text{NH}_3, \text{SbH}_3, \text{AsH}_3$$
 Delhi 2010
71. Why nitrogen gas is very unreactive? All India 2014C
72. Explain the following:
The chemical reactivity of nitrogen is much less than that of phosphorus. Foreign 2012; All India 2012;
Delhi 2009, 2008C
73. Draw the structure of PCl_5 (s). All India 2014C; 2009, 2008
74. What is the covalency of nitrogen in N_2O_5 ? Delhi 2013, All India 2010C
75. What is the basicity of H_3PO_3 and why? All India 2013, 2011
76. Draw the structure of $(\text{HPO}_3)_3$. Delhi 2013, All India 2011, 2009, 2009C
77. Why does PCl_3 fume in moisture? Delhi 2013C

78. Which one of PCl_4^+ and PCl_4^- is not likely to exist and why? Delhi 2012
79. Complete the following chemical reaction equation: $\text{P}_4 + \text{SO}_2\text{Cl}_2 \rightarrow$ Delhi 2012
80. Draw the structure of the molecule H_3PO_2 . Delhi 2012; All India 2012, 2009
81. Which is a stronger reducing agent, SbH_3 or BiH_3 and why? All India 2012, 2011
82. NF_3 is an exothermic compound whereas NCl_3 is not. Explain. All India 2012, 2011; Delhi 2011, 2010
83. Draw the molecular structure of N_2O_5 . All India 2012, 2009
84. Write the formula of the compound of phosphorus which is obtained when conc. HNO_3 oxidises P_4 . All India 2017
85. Which is a stronger oxidizing agent— $\text{Bi}(\text{v})$ or $\text{Sb}(\text{v})$? Assam Board-2022
86. What are the neutral oxides of nitrogen? Telangana Board-2023
87. Discuss the principles involved in the preparation of ammonia by Haber's process. What happens when (i) ammonia is heated with oxygen in presence of platinum gauge at 500°C and (ii) ammonia is passed through copper sulphate solution? Odisha Board-2020
88. Draw the Electron dot formula of PCl_5 . Tamil Nadu Board-2015
89. How does dinitrogen reacts with active metals and non metals separately. Write one relevant equation of each. Manipur Board-2018
90. At a given temperature and pressure nitrogen gas is more soluble in water than helium gas. Which one of them has higher value of K_H . Karnataka Board-2015
91. What happens when white phosphorus is heated with conc. NaOH solution in an inert atmosphere of CO_2 ? Andhra Pradesh Board-2019
92. (a) Why bond angle of Phosphine (PH_3) is less than Ammonia (NH_3) ?
 (b) Why H_2S is less acidic than H_2Te ? Punjab Board-2019
93. Why nitrous acid is oxidant as well as reluctant? Punjab Board-2021
94. What is the basicity of H_3PO_4 and why? Punjab Board-2021
95. Why does NCl_5 not exist? Punjab Board-2021
96. Why does nitrogen show catenation properties less than phosphorus ? Haryana Board-2019
97. Why does NH_3 form hydrogen bonding while PH_3 does not ? Jharkhand Board-2018
98. In the manufacture of ammonia by Haber's process. Write the flow chart and chemical equation with optimum conditions. Karnataka Board-2019
99. PCl_5 exists, but NCl_5 does not. Why? Chhattisgarh Board-2022
100. Draw the structure of H_3PO_2 and account for its reducing character. Kerala Board-2019
101. The weakest reducing agent among the hydrides of group 15 elements is _____. Kerala Board-2019
102. Draw the structures of the following compounds :
 (a) N_2O_5
 (b) HClO_4
 (c) XeF_2
 (d) $\text{H}_2\text{S}_1\text{O}_1$
 (e) H_2SO_4 Jharkhand Board-2020
103. In Haber's process of ammonia synthesis, presence of traces of H_2S retards the rate of the reaction. Why ? Manipur Board-2019
104. Nitrogen molecule is highly stable - Why ? Andhra Pradesh Board-2021
105. (a) Account for the following
 (i) NH_3 acts as a Lewis base.
 (ii) PCl_3 fumes in moist air.
 (iii) Fluorine shows only - 1 oxidation state. Kerala Board-2016
106. Explain the following:
 (a) BiH_3 is a stronger reducing agent as compared of NH_3 . Haryana Board-2018
107. What is the basicity of H_3PO_3 ? Rajasthan Board-2015
108. Show that phosphine is a very good reducing agent. Tamilnadu Board, Sep.-2016
109. How silver nitrate reacts with orthophosphoric acid? Tamilnadu Board, March-2016
110. (i) What is the oxidation state of phosphorus in H_3PO_3 ? Assam Board-2020
111. Give reasons:
 (i) Though nitrogen exhibits +5 oxidation states but it does not form pentahalide. Assam Board-2020
112. Write the molecular formula and structural formula of the following substances.
 (a) Phosphinic acid
 (b) Olcum
 (c) Perbromic acid Gujarat Board-2018

113. Give the structural formula of H_3PO_2 .
Assam Board-2018
114. Why is N_2 less reactive at room temperature?
Assam Board-2018
115. Mention the basicity of H_3PO_4 .
Assam Board-2016
116. Complete the following reactions
(i) $\text{P}_4 + 3\text{NaOH} + 3\text{H}_2\text{O} \xrightarrow{\text{?}}$
Assam Board-2015
117. Complete the following reactions
(ii) $2\text{F}_2(\text{g}) + 2\text{H}_2\text{O}(l) \xrightarrow{\text{?}}$
Assam Board-2015
118. Give the electronic configuration of group 15 elements.
J & K board-2023
119. (a) Why nitrogen exists as a diatomic molecule, N_2 whereas phosphorus exists as P_4 ?
Meghalaya Board-2021
120. Write the preparation of ammonia by Haber process. Give one use.
Nagaland Board-2021
- Section-C : Short Answer**
1. Explain why NH_3 is basic in nature.
UP Board 2023
2. (a) Account for the following :
(i) Tendency to show -3 oxidation state decreases from N to Bi in group 15.
(ii) Acidic character increases from H_2O to H_2Te .
(iii) F_2 is more reactive than ClF_3 , whereas ClF_3 is more reactive than Cl_2 .
(b) Draw the structure of (i) XeF_2 , (ii) $\text{H}_4\text{P}_2\text{O}_7$.
CBSE-2019
3. (a) (i) Write the disproportionation reaction of H_3PO_3 .
(ii) Draw the structure of XeF_4 .
(b) Account for the following :
(i) Although Fluorine has less negative electron gain enthalpy yet F_2 is strong oxidizing agent.
(ii) Acidic character decreases from N_2O_3 to Bi_2O_3 in group 15.
(c) Write a chemical reaction to test sulphur dioxide gas. Write chemical equation involved.
CBSE-2019
4. Account for the following :
(a) Bi(V) is a stronger oxidizing agent than Sb(V).
(b) $\text{H}-\text{O}-\text{I}$ is a weaker acid than $\text{H}-\text{O}-\text{Cl}$.
(c) Bond angle decreases from H_2O to H_2S .
CBSE-2019
5. Give reasons for the following :
(a) Acidic character decreases from N_2O_3 to Bi_2O_3
(b) All the P – Cl bonds in PCl_5 are not equivalent.
(c) HF is a weaker acid than HCl in an aqueous solution.
CBSE-2019
6. Given reasons for the following:
(i) Red phosphorus is less reactive than white phosphorus.
(ii) Electron gain enthalpies of halogens are largely negative.
(iii) N_2O_5 is more acidic than N_2O_3 .
All India 2017
7. Given reasons for the following:
(i) $(\text{CH}_3)_3\text{P} = \text{O}$ exists but $(\text{CH}_3)_3\text{N} = \text{O}$ does not.
(ii) Oxygen has less electron gain enthalpy with negative sign than sulphur.
(iii) H_3PO_2 is a stronger reducing agent than H_3PO_3 .
Delhi 2014
8. What happens, when – (any three)
(a) P_4O_{10} is treated with dil. HNO_3 .
(b) Cl_2 is treated with hot and conc. NaOH
(c) Reaction of ammonia with excess Cl_2 gas
(d) Orthophosphoric acid is heated
Assam Board-2022
9. (b) Give the laboratory method of preparation of Phosphine and also write equation of the related reaction.
Uttarakhand Board-2020
10. Mention basicity and oxidation number of phosphorus in phosphinic acid.
Gujarat Board-2021
11. Explain manufacturing of ammonia gas by Haber's process and write the uses of ammonia gas.
Gujarat Board-2016
12. Explain preparation of Nitric acid by Ostwald's method and write the uses of nitric acid.
Gujarat Board-2016
13. Give the electronic structure of following:
(a) PCl_5
(b) H_3PO_3
Tamil Nadu Board-2011
14. Write about plumbo solvency.
Tamil Nadu Board-2011
15. Write the action of aqua regia on gold.
Tamil Nadu Board-2011
16. What is spitting of silver? How is it prevented?
Tamil Nadu Board-2011
17. (a) Give reasons :
(i) H_3PO_3 undergoes disproportionation reaction but H_3PO_4 does not.
(ii) When Cl_2 reacts with excess of F_2 , ClF_3 is formed and not FCl_3 .
(iii) Dioxygen is a gas while Sulphur is a solid at room temperature.
(b) Draw the structures of the following :
(i) XeF_4
(ii) HClO_3
UP Board-2018

Section-D : Case Based Study

1. (a) Describe with diagram the manufacturing method of HNO_3 .
UP Board 2019
2. Explain preparation of Ammonia from Habers Process under following headings :
 (i) Diagram
 (ii) Method description
 (iii) Equation
MP Board 2020
3. Give reasons for the following:
 (a) NO_2 dimerises readily.
 (b) Chlorine acts as a bleaching agent.
 (c) In spite of small size, electron gain enthalpy of oxygen is less negative as compared to sulphur.
 (d) Unlike chlorine, fluorine forms only one oxoacid, HOF .
 (e) Noble gases have very low boiling points.
CBSE-2019

Section-E : Long Answer

1. (a) (i) Account for the following:
 (I) NH_3 is a stronger base than PH_3 .
 (II) Oxygen shows -2 oxidation state except in OF_2 .
 (III) Fluorine shows anomalous behaviour.
 (ii) What happens when
 (I) Cl_2 reacts with cold and dilute NaOH ; and
 (II) Cu reacts with concentrated H_2SO_4 ?
CBSE-2021
2. (a) How is Nitric acid manufactured by Ostwald's process?
Telangana Board-2017
3. (a) Give one example to show the anomalous reaction of fluorine.
 (b) What is the structural difference between white phosphorus and red phosphorus?
 (c) What happens when XeF_6 reacts with NaF ?
 (d) Why is H_2S a better reducing agent than H_2O ?
 (e) Arrange the following acids in the increasing order of their acidic character:
 $\text{HF, HCl, HBr and HI}$
CBSE-2019
4. (a) Complete the following reactions:
 (i) $\text{PbS(s)} + \text{O}_3 \rightarrow$
 (ii) $\text{XeF}_6 + \text{NaF} \rightarrow$
 (b) Arrange the following in increasing order of property indicated, giving reason :
 (i) Hydrides of group 15 – boiling points
 (ii) Hydrides of group 17 – acidic strength
 (iii) Hydrides of group 16 – reducing character
CBSE-2019

5. (i) Account for the following:

(a) Bi is a strong oxidizing agent in the $+5$ oxidation state

(b) PCl_5 is known but NCl_5 is not known

(c) Iron dissolves in HCl to form FeCl_2 and not FeCl_3

(ii) Draw the structures of the following:

(a) XeOF_4 (b) HClO_4

Foreign 2014

(i) using VSEPR theory, predict the probable structures of the following:

(a) N_2O_3 (b) BrF_3

(ii) Arrange the following groups of substances in the order of the property indicated against each group:

(a) $\text{NH}_3, \text{PH}_3, \text{AsH}_3, \text{SbH}_3$

–increasing order of boiling points

(b) O, S, Se, Te – increasing order of electron gain enthalpy with negative sign

(c) $\text{F}_2, \text{Cl}_2, \text{Br}_2, \text{I}_2$ – increasing order of bond dissociation enthalpy

Delhi 2014C

(i) Compare the oxidizing action of F_2 and Cl_2 by considering parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy.

(ii) Write the conditions to maximize the yield of H_2SO_4 by contact process.

(iii) Arrange the following in the increasing order of property mentioned.

(a) $\text{H}_3\text{PO}_3, \text{H}_3\text{PO}_4, \text{H}_3\text{PO}_2$

(Reducing character)

(b) $\text{NH}_3, \text{PH}_3, \text{AsH}_3, \text{SbH}_3, \text{BiH}_3$

(Basic strength)

All India 2015

(i) Complete the following chemical reaction equations:

(a) $\text{Cu} + \text{HNO}_3$ (dil.) \rightarrow

(b) $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \rightarrow$

(ii) (a) Why does $\text{R}_3\text{P} = 0$ exist but $\text{R}_3\text{N} = 0$ does not? (R = alkyl group)

(b) Why is dioxygen a gas but sulphur a solid?

(c) Why are halogens coloured?

Delhi 2015C

Describe the preparation of Nitric Acid by Ostwald process. Give chemical equation of the related reaction also. What is aqua regia?

Uttarakhand Board-2020

Answer the following:

(a) Why does the stability of $+5$ oxidation state of group 15 elements decrease down the group?

(b) Write the hydrides of group 15 elements in the decreasing order of their basicity.

(c) Write a balanced chemical equation to show the hydrolysis of calcium phosphide.

(d) Name of oxoacid of phosphorus which shows reducing property.

Goa Board-2023

11. a) Although geometries of NH_3 and H_2O molecules are distorted tetrahedral, bond angle in H_2O is less than that of NH_3 . Explain why.
 b) Why is concept of resonance needed? What is a resonance hybrid? How does it differ from canonical structures drawn for a molecule? Explain with the help of an example. Draw canonical structures of dinitrogen oxide (N_2O).
 NIOS Board-2021
12. An oxyacid of phosphorus is triprotic in nature. Identify the compound and draw its electron dot formula.
 Tamil Nadu Board-2018
13. (a) How does the VSEPR theory explain the :
 (i) trigonal pyramidal structure of ammonia and
 (ii) bent structure of water ? Draw their structures also
 (b) Write down the molecular orbital electronic configuration of following species and compute their bond order :
 Li_2 , Be_2
 Predict which of these may not exist and why ?
 [Atomic number : Li = 3, Be = 4]
 NIOS Board-2015
14. (a) Name the nitrogenous fertilizer having the maximum nitrogen content. Write its method of preparation giving chemical equation involved.
 (b) Given reasons for the following :
 (i) Aluminium becomes passive when dipped in conc. HNO_3 .
 (ii) A black mass is formed when conc. H_2SO_4 is poured over sugar.
 NIOS Board-2014
15. (a) Define an ionic bond. List three conditions which favour the formation of an ionic compound.
 (b) What is meant by 'hybridization' ? Explain the shape of PCl_5 molecule on the basis of hybrid orbitals.
 (c) Be_2 molecule does not exist. Explain on the basis of molecular orbital theory.
 (d) Write the MO electronic configuration of N_2 molecule and deduce its bond order.
 NIOS Board-2012
16. (i) How is nitric acid manufactured by Ostwald process ?
 (ii) Write down the reaction of Ozone with black lead sulphide.
 (iii) Draw structure of IF_7
 Punjab Board-2017
17. Answer the following :
 (a) Draw the structure of PCl_5 .
 (b) Write any two reasons for anomalous behaviour of nitrogen.
 (c) Name the allotrope of phosphorous that exhibits chemiluminescence.
 (d) Arrange the hydrides of group 15 elements in the decreasing order of their basicity.
 Goa Board-2018
18. How is phosphine prepared in laboratory?
 How does it react with (a) CuSO_4 and (b) HgCl_2 ?
 Jharkhand Board-2018
19. Give the electronic configuration of the elements of group 15. Why nitrogen shows anomalous behaviour? Explain with examples the various oxidation states of nitrogen.
 J&K Board-2019
20. With respect to group 15 elements, answer the following :
 (i) Comment on the trend in ionization enthalpy giving reason :
 (ii) Write any two reasons for the anomalous behavior of nitrogen.
 (iii) Draw the structure of H_3PO_4 .
 (iv) Write a chemical equation for the preparation of PH_3 .
 Goa Board-2019
21. (i) Write the chemical reaction when PCl_5 is strongly heated.
 (ii) What are interhalogen compounds ? Give two examples.
 (iii) Explain the steps involved in the contact process for the manufacture of H_2SO_4
 Kerala Board-2022
22. (a) Draw the structure of HNO_3 and write its two uses.
 (b) HF is a weaker acid than HI. Explain.
 Haryana Board-2017
23. How will you prepare HNO_3 by Ostwald process?
 Haryana Board-2017
24. How will you prepare PH_3 from :
 (a) Metal phosphide
 (b) H_3PO_4
 (c) PCl_3 and draw structure of PH_3
 Haryana Board-2016
25. (a) How is ammonia manufactured industrially ? Describe with diagram. [3]
 (b) Give the name and formula of two Oxoacids of phosphorous. [2]
 Uttarakhand Board-2019
26. Either
 (a) How is nitric acid manufactured by Ostwald's process ?
 (b) How is XeF_2 prepared ? What happens when it is hydrolyzed completely ?
 (c) Why do the halogens show an oxidation state of -1 ?
 Manipur Board-2022
27. (d) How is phosphine prepared in the laboratory ?
 (e) Ferric ion is more stable than ferrous ion. However when finely powdered iron reacts with hydrochloric acid, ferrous chloride is produced. Give reason.
 (f) Why does oxygen rarely show positive oxidation state while the other group 16 elements show more positive oxidation state ?
 Manipur Board-2022

28. Answer the following:
 (a) Why does the stability of +5 oxidation state of group 15 elements decrease down the group?
 (b) Write the hydrides of group 15 elements in the decreasing order of their basicity.
 (c) Write a balanced chemical equation to show the hydrolysis of calcium phosphide.
 (d) Name the oxoacid of phosphorus which shows reducing property.
- Goa Board-2019
29. Draw structure of H_3PO_3 and H_3PO_4 Molecules. Also give their basicity.
- Haryana Board-2018
30. Discuss Abnormal behaviour of Nitrogen.
- Haryana Board-2018
31. (a) Write oxidation state of nitrogen in nitric acid.
 (b) What happens when sulphur reacts with concentrated H_2SO_4 ? Give chemical equation.
 (c) Why helium is used as diluent for oxygen in modern diving apparatus? Explain.
 (d) Draw the structure of HClO_3 .
- Rajasthan Board-2019
32. (a) Write hybridized state of nitrogen atom in ammonia.
 (b) What happens when carbon reacts with concentrated H_2SO_4 ? Give chemical equation.
 (c) Why interhalogen compounds are more reactive than halogen compounds? Explain.
 (d) Draw the structure of XeF_6 .
- Rajasthan Board-2019
33. Write a chemical equation to prepare ammonia from ammonium chloride?
- Rajasthan Board-2016
34. Write a chemical equation to identify Cu^{+2} and Ag^+ ions with the application of NH_3 ?
- Rajasthan Board-2016
35. Draw a labelled diagram showing flowchart for the manufacture of ammonia?
- Rajasthan Board-2016
36. Write equations of brown ring test.
- Rajasthan Board-2013
37. Draw the structure of PCl_5 molecule.
- Rajasthan Board-2013
38. Write the name and electronic configuration of metal element of group 15.
- Rajasthan Board-2013
39. Give equations for the reactions of dilute and concentrated HNO_3 with Zn.
- Rajasthan Board-2013
40. Explain the shape of p-orbitals.
- Tamilnadu Board, Sep.-2016
41. How colloids are prepared by Mechanical dispersion method and Electro dispersion method?
- Tamilnadu Board, March-2016
42. Draw the structure of orthophosphorus, orthophosphorus and pyrophosphoric acid. Also gives order of acidic strength.
- Gujarat Board-2018
43. State the chemical reaction of Cu with dilute HNO_3 and P_4 with con. HNO_3
- Gujarat Board-2018
44. Give two methods of preparation of PCl_5 and discuss the structure of PCl_5 .
- Haryana Board-2016
45. Name any five oxoacids of phosphorus and write their formula.
- Haryana Board-2016
46. Describe the manufacture of ammonia by Haber's process with favourable conditions.
- Assam Board-2019
47. Explain why HNO_2 behaves both as oxidising as well as reducing agent.
- Assam Board-2017
48. Give a laboratory method of preparation of dinitrogen.
- Assam Board-2017
49. Describe the manufacture of ammonia by Haber's process with favourable conditions.
- Assam Board-2015
50. (i) Explain the hydrides of Nitrogen family under the following points:
 (a) Basic property
 (b) Reducing property
 (c) Melting and Boiling point.
- MP Board-2018
51. Write four different chemical reaction of copper with nitric acid. Give equations also.
- MP Board-2017
52. Draw a Labelled diagram of Ostwald method for preparation of Nitric Acid and explain its preparation only by equation.
- MP Board-2016
53. Write the name and structure of any five oxy acids of phosphorus.
- MP Board-2015
54. Explain the hydrides of nitrogen family under the following points:
 (i) Name and formula
 (ii) Basic property
 (iii) Reducing property
 (iv) Bond angle
 (v) Melting and Boiling point.
- MP Board-2014
55. Draw labelled diagram of Haber process for the manufacture of Ammonia and write chemical equation.
- MP Board-2012
56. Draw labelled diagram of Laboratory method of phosphine and give chemical equation.
- MP Board-2012
57. Name the elements of nitrogen family based on the electronic configuration explain the valence of N and P. Give common oxidation states of nitrogen.
- Or
- How is sulphuric acid manufactured by contact process ? Why is sulphuric acid syrupy (viscous) ?
- J&K Board-2020

58. Name the elements of group 15 and discuss their oxidation states.

J & K Board-2021

59. How does ammonia react with a solution of Cu^{2+} ions?

Meghalaya Board-2019

60. Draw the structure of cyclometaphosphoric acid.

61. Write the principle and conditions involved giving stepwise reaction for the manufacture of H_2SO_4 by contact process.

Meghalaya Board-2019

62. HCl reacts with powdered Fe to give FeCl_2 and not FeCl_3 . Why?

63. When NaBr is heated with conc. H_2SO_4 , Br_2 is produced. But when NaCl is heated with conc. H_2SO_4 , HCl is produced. Explain with chemical equations.

64. Complete the following reactions :



Meghalaya Board-2019

65. (a) Why does NH_3 act as a Lewis base?

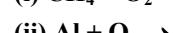
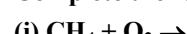
- (b) How does ammonia react with an aqueous solution of Cu^{2+} ?

- (c) Mention any two conditions required to maximise the yield of ammonia by Haber's process.

OR

- (d) Why does O_3 act as a powerful oxidizing agent?

- (e) Complete the following reactions:



Meghalaya Board-2021

66. (i) Explain the basic strengths of hydrides of group-15 elements.

- (ii) Give reason for the following:

- a. Nitrogen does not form pentahalide like phosphorous.

- b. Electron gain enthalpy of chlorine is higher than fluorine.

Nagaland Board-2018

67. (i) Give the comparative account of thermal stability of hydrides of group 16 element.

- (ii) Write the preparation of ammonia by Haber's process. What are the reaction conditions involved in it ?

Nagaland Board-2017

E. Oxygen Family (Group 16-Elements)

Section-A : Multiple Choice Questions

1. Which gas is used in Holme's signal?

- (a) SO_2 (b) NO_2
(c) H_2S (d) PH_3

Gujarat Board 2023 (March)

Ans. (d)

2. Which order for thermal stability of the following compounds is correct?

- (a) $\text{H}_2\text{Te} > \text{H}_2\text{Se} > \text{H}_2\text{O} > \text{H}_2\text{S}$
(b) $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$
(c) $\text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te} > \text{H}_2\text{O}$
(d) $\text{H}_2\text{Te} > \text{H}_2\text{Se} > \text{H}_2\text{S} > \text{H}_2\text{O}$

Gujarat Board 2023 (March)

Ans. (b)

3. Molecular formula of sulphur at ordinary temperature is

- (a) S_2 (b) S_4
(c) S_6 (d) S_8

UP Board 2023

Ans. (d)

4. Peroxo bond is present in—

- (a) H_2SO_5 (b) H_2SO_3
(c) $\text{H}_2\text{S}_2\text{O}_6$ (d) $\text{H}_2\text{S}_2\text{O}_7$

Gujarat Board-2021

Ans. (a)

5. The formula of sulphur molecule is

- (a) S_2 (b) S_4
(c) S_8 (d) S_6

Odisha Board-2020

Ans. (c)

6. Which one of the following has $\text{S} - \text{O} - \text{S}$ bond?

- (a) $\text{H}_2\text{S}_2\text{O}_8$ (b) $\text{H}_2\text{S}_2\text{O}_7$
(c) $\text{H}_2\text{S}_2\text{O}_4$ (d) $\text{H}_2\text{S}_2\text{O}_6$

NIOS Board-2021

Ans. (d)

7. The intermediate compound produced in the formation of SO_3 by lead chamber process is:

- (a) NO (b) NO_2
(c) SO_2 (d) O_2

Tamil Nadu Board-2016

Ans. (a)

8. Hydrogen peroxide is used as

- (a) oxidizing agent
(b) reducing agent
(c) both oxidizing and reducing agent
(d) drying agent

NIOS Board-2016

Ans. (c)

9. Which of the following oxidation state of oxygen is +2

- (a) Cl_2O (b) O_2F_2
(c) OF_2 (d) N_2O

Punjab Board-2021

Ans. (c)

14. Write any two oxoacids of sulphur and draw their structures. CBSE-2019
15. Complete and balance the following equations:
 (a) $S + H_2SO_4$ (conc.) \rightarrow
 (b) $PCl_3 + H_2O \rightarrow$ CBSE-2019
16. Draw structures of the following :
 (a) $H_2S_2O_7$
 (b) $HClO_3$ CBSE-2019
17. How can ozone be manufactured by Siemen's ozoniser? How is pure ozone recovered from the products? ISC Board-2010
18. What are the following converted to when hydrogen peroxide reacts with them? What type of reagent is hydrogen peroxide in each of these reactions?
 (a) Lead sulphide
 (b) Silver oxide
 (c) Sodium hydroxide ISC Board-2002
19. Write the balanced chemical equations for each of the following reactions:
 (a) Hydrogen peroxide with acidified ferrous sulphate solution.
 (b) Ozone with moist iodine ISC Board-2006
20. Hydrogen peroxide is used for restoring the colour of lead paintings. give reason. ISC Board-2006
21. Give a balanced equation for a reaction in which hydrogen peroxide acts as a reducing agent and one in which it acts as an oxidising agent. ISC Board-2007
22. How is hydrogen peroxide prepared in the laboratory? ISC Board-2007
23. Give the balanced equation for the following reaction.
 (a) Ozone and mercury.
 (b) Action of heat on a mixture of sodium chloride and concentrated sulphuric acid. ISC Board-2012
24. Write the balanced chemical equations for the following reactions:
 (a) Ozone and lead sulphide.
 (b) Sulphuric acid is treated with phosphorus: ISC Board-2014
25. When hydrogen sulphide reacts with sulphur dioxide to give sulphur and water,
 (a) both H_2S and SO_2 are oxidised
 (b) both H_2S and SO_2 are reduced
 (c) H_2S is oxidized and SO_2 is reduced
 (d) H_2S is reduced and SO_2 is oxidised ISC Board-2004
26. Discuss the theory involved in the manufacture of sulphuric acid by contact process. ISC Board-2017
27. Give the balanced equation for the following: Hydrogen peroxide with sodium hydroxide. ISC Board-2009
28. Give the balanced equation for the following: Ozone and hydrogen sulphide. ISC Board-2009
29. Give the balanced chemical equation: Sulphuric acid is treated with hydrogen sulphide. ISC Board-2015
30. Give the balanced chemical equation for the following reaction: Hydrogen sulphide is treated with concentrated sulphuric acid. ISC Board-2013
31. Give the balanced chemical equation: Ozone is treated with potassium iodide solution. ISC Board-2017
32. Sulphur dioxide acts as an oxidising agent as well as a reducing agent. Given one reaction each to show its oxidising nature and its reducing nature. ISC Board-2016
33. The molecular weight of H_2S is more than that of H_2O , but H_2S is a gas and H_2O a liquid Explain. ISC Board-2012
34. SF_6 exists but OF_6 does not, though both oxygen and sulphur belong to the same group in the periodic table. ISC Board-2010
35. Explain the following giving an appropriate reason: O_2 and F_2 both stabilise higher oxidation states of metals but O_2 exceeds F_2 in doing so. HOTS; Delhi 2012; All India 2011
36. Explain: The two oxygen-oxygen bond lengths in ozone (O_3) molecule are same. All India 2011C
37. Elements of group 16 generally show lower value of first ionisation enthalpy as compared to the corresponding elements in the period of group 15. Explain why? All India 2011C
38. O_3 acts as a powerful oxidising agent. Give reason. Delhi 2011 C; All India 2010
39. The value of electron gain enthalpy with negative sign for sulphur is higher than that for oxygen. Give reason. Delhi 2010; All India 2010
40. The electron gain enthalpy with negative sign for oxygen (-141 kJ mol^{-1}) is numerically less than that for sulphur (-200 kJ mol^{-1}). Give reason. Foreign 2008

41. Draw the structure of O_3 molecule. Delhi 2010
42. H_2S is less acidic than H_2Te . Why? Foreign 2010 ; All India 2010C; Delhi 2008C
43. OF_6 compound is not known. Why? Delhi 2010C, 2009C
44. Write the balanced chemical equation for the following reaction:
Excess of SO_2 reacts with sodium hydroxide solution. Delhi 2010C, Delhi 2009
45. Sulphur hexafluoride is less reactive than sulphur tetrafluoride. Why? Delhi 2010C; All India 2008
46. Why are the two S—O bonds in SO_2 molecule of equal strength? All India 2010C
47. SF_4 is easily hydrolysed whereas SF_6 is not easily hydrolysed. Explain with reason. Delhi 2009
48. Draw the structure of SO_3^{2-} . All India 2009
49. Which one has higher electron gain enthalpy with negative sign, sulphur or oxygen? Foreign 2009
50. In solution of H_2SO_4 in water, the second dissociation constant, K_{a_2} is less than the first dissociation constant, K_{a_1} . Explain. HOTS; Foreign 2009
51. Complete the following reaction equation:
 $SO_2 + MnO_4^- + H_2O \rightarrow$ Foreign 2009
52. H_2O is a liquid while, in spite of a higher molecular mass, H_2S is a gas. Explain. Foreign 2009
53. Complete the following chemical equation: Delhi 2009; Foreign 2008
 $O_3(g) + I^- (aq) + H_2O(l) \rightarrow$
54. Draw the structure of SF_4 molecule. Delhi 2008
55. Draw the structure of $S_8(g)$ molecule. All India 2008
56. Describe the favourable conditions for the manufacture of sulphuric acid by contact process. All India 2008
57. Oxygen molecule has the formula O_2 while sulphur has S_8 . Give reason. Delhi 2008C
58. Draw the structure of SO_2 molecule. Comment on the nature of two S—O bonds formed in it. Are the two S—O bonds in this molecule equal? All India 2008C
59. What happens when
(a) conc. H_2SO_4 is added to Cu?
(b) SO_3 is passed through water?
Write the equations. Delhi 2017
60. Name the two most important allotropes of sulphur. Which one of the two is stable at room temperature? What happens when the stable form is heated above 370 K? Foreign 2014
61. (i) Write the conditions to maximise the yield of H_2SO_4 by contact process.
(ii) Why is $K_{a_2} \ll K_{a_1}$ for H_2SO_4 in water? Foreign 2014
62. Draw the structures of each of the following:
(i) H_2SO_4 (ii) Solid PCl_5
Delhi 2014C
63. Complete the following chemical equations:
(i) $Ca_3P_2 + H_2O \rightarrow$
(ii) $Cu + H_2SO_4$ (conc.) \rightarrow All India 2014
64. Draw the structures of the following compounds:
(i) H_2SO_3 (ii) N_2O_5
All India 2012; Delhi 2014
65. Account for the following:
(i) Decomposition of O_3 molecule is a spontaneous process.
(ii) SF_6 is inert towards hydrolysis. Delhi 2013C
66. Account for the following:
(i) H_2S is less acidic than H_2Te .
(ii) SO_2 is an air pollutant. Delhi 2013C
67. Draw the structures of O_3 and S_8 molecules. Foreign 2010
68. Write the formulae of any two oxoacids of sulphur. All India 2015
69. Which allotrope of sulphur is thermally stable at room temperature? Foreign 2015
70. Account for the following:
Oxygen shows catenation behaviour less than sulphur. Delhi 2012
71. Sulphur has a greater tendency for catenation than oxygen. Why? All India 2012, 2009; Delhi 2011, 2009; Foreign 2009
72. Sulphur exhibits tendency for catenation but oxygen does not do so. Give reason. All India 2009C
73. Draw the structure of $H_2S_2O_8$. Delhi 2013; Delhi 2012; foreign 2012, 2014; All India 2009, 2009C
74. Predict the shape and the asked angle (90° or more or less) in the following case:
 SO_3^{2-} and the angle in O—S—O. Delhi 2012
75. Of PH_3 and H_2S , which is more acidic and why? Delhi 2012

76. All India bonds in SF_4 are not equivalent. Explain, why?
All India 2012
77. Oxygen is a gas but sulphur is a solid. Explain.
All India 2012; All India 2010
78. Give reason: H_2S is more acidic than H_2O .
Foreign 2012; All India 2012, 2011; Delhi 2011C, 2010C, 2009C
79. Draw the structure of $\text{H}_2\text{S}_2\text{O}_7$.
Delhi 2012; All India 2009; Foreign 2009
80. SF_6 is kinetically inert substance. Explain.
Foreign 2012; Delhi 2011; All India 2011
81. Sulphur in vapour state exhibits paramagnetic behaviour. Give reason.
Delhi 2012, 2008; Foreign 2010, 2009; All India 2008
82. Complete the following chemical equations:
 $\text{SO}_3 + \text{H}_2\text{SO}_4 \text{ (conc.)} \rightarrow$
All India 2011
83. What happens when sulphur dioxide gas is passed through an aqueous solution of a Fe(III) salt?
All India 2011
84. What is blister copper. Why is it so called?
Telangana Board-2023
85. The thermal stability of the hydrides of Group 16 _____ down the group.
Odisha Board-2017
86. Reason for viscous nature of concentrated sulphuric acid is _____.
Chhattisgarh Board-2023
87. What happens when sulphur dioxide gas is passed through lime water first slowly and then in excess?
Odisha Board-2020
88. What is the action of heat on orthophosphoric acid?
Tamil Nadu Board-2011
89. Write one method of preparation of sulphur dioxide. Explain bleaching action of SO_2 .
Manipur Board-2018
90. When S reacts with H_2SO_4 , a colourless gas with pungent odour evolves which acts as a mild bleaching agent in the presence of moisture. Identify the gas and explain its bleaching action.
NIOS Board-2018
91. Mention two differences between balancing action of SO_2 and Cl_2 .
West Bengal Board-2019
92. Why is dioxygen a gas but sulphure a solid?
Punjab Board-2021
93. Oxygen is a gas while sulphur is solid. explain
Punjab Board-2021
94. Complete the following reactions :
 (i) $\text{Cl}_2 + \text{H}_2\text{O}_2 + 2\text{KOH} \rightarrow$
 (ii) $2\text{FeSO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{O}_2 \rightarrow$
NIOS Board-2022
95. Write down the structures of the following compounds :
 (i) $\text{H}_2\text{S}_2\text{O}_8$
 (ii) $\text{H}_2\text{S}_2\text{O}_3$
NIOS Board-2023
96. Complete the following reactions and balance it.
 (a) $\text{Cu}_{(s)} + \text{H}_2\text{SO}_{4(\text{conc})(l)} \rightarrow$
 (b) $\text{P}_{4(s)} + \text{NaOH}_{(\text{aq})} + \text{H}_2\text{O}_{(l)} \rightarrow$
Gujarat Board-2019
97. In SF_6 hybridisation of Sulphur is
Haryana Board-2022
98. Sulphur dioxide has reducing as well as oxidizing property. Write two reactions to illustrate the character.
Manipur Board-2022
99. (a) Account for the following :
 (i) H_2O is a liquid while H_2S is a gas.
 (ii) Noble gases have very low boiling points.
 (iii) NO_2 dimerises to N_2O_4 .
 (b) (i) What are interhalogen compounds?
 (ii) Suggest any two examples of interhalogen compounds.
Kerala Board-2016
100. Draw a diagram of “two dimension square closed packing”.
Rajasthan Board-2018
101. What happens when SO_2 is pass through water?
Rajasthan Board-2016
102. Write reaction showing reducing property of sulphur dioxide.
Rajasthan Board-2016
103. Draw a labelled diagram showing ring structure of rhombic sulphur?
Rajasthan Board-2016
104. Arrange and write $\text{O}^{\oplus}, \text{O}_2^{\oplus\oplus}$ and $\text{O}_2^{2\ominus}$ in increasing bond order.
Rajasthan Board-2010
105. What is inert pair effect?
Tamilnadu Board, March-2016
106. Give reasons:
 (iii) NH_3 form hydrogen bond but PH_3 does not.
Assam Board-2020
107. What is Oleum?
Assam Board-2018
108. Answer the following:
 (a) Ozone acts as a powerful oxidizing agent. Given reason.
 (b) Complete the following reaction:

$$\text{HNO}_3 \xrightarrow[\text{D}]{\text{P}_4\text{O}_{10}} ?$$

 (c) Which reaction was used by Bartlett to prepare the first noble gas compound
 (d) KHF_2 is known but KHCl_2 is not known. Given reason.
 (e) Bismuth is a strong oxidizing agent in the pentavalent state (O.N. = 5). Give reason.
Assam Board-2013

109. Answer the following:
 (a) Why H_2O is a liquid whereas H_2S is gas at room temperature?
 (b) Arrange the following in increasing order of acid strength:
 HCl, HI, HBr, HF
 (c) Complete the following equation:
 $XeF_6 + H_2O \longrightarrow$
 (d) Explain the bleaching action of chlorine.
- Assam Board-2012
- Section-C : Short Answer**
1. H_2SO_4 How does it react with-
 (i) Carbon, (ii) H_2S and (iii) Iodine ?
 Give equations of all the related reactions.
- UP Board 2019
2. Complete the following reactions.
 (i) $P_4 + NHO_3 \rightarrow$
 (ii) $C + H_2SO_4 \rightarrow$
 (iii) $Cl_2 + NaOH$ (Cold and dilute) \rightarrow
- Gujarat Board-2022 (July)
3. (i) Give reason that bleaching action of chlorine is permanent while that of SO_2 is temporary.
- UP Board 2023
4. Why does O_3 act as a powerful oxidising agent?
 Uttarakhand Board 2023
5. (i) Elements of group 16 generally show lower value of first ionisation enthalpy compared to the corresponding periods of group 15. Why?
 (ii) Why is H_2O a liquid and H_2S a gas?
- OR
- (i) Describe laboratory method of preparation of Sulphur dioxide
 (ii) Which form of Sulphur shows Paramagnetic behaviour?
- Uttarakhand Board 2022
6. Account for the following:
 (a) Sulphurous acid is a reducing agent.
 (b) Fluorine forms only one oxoacid.
 (c) Boiling point of noble gases increases from He to Rn.
- CBSE-2020
7. Account for the following :
 (a) H_3PO_3 disproportionates whereas H_3PO_4 does not.
 (b) On addition of ozone to KI solution, violet vapours are obtained.
 (c) Chlorine water has both, oxidizing and bleaching properties.
- CBSE-2019
8. When concentrated sulphuric acid was added to an unknown salt present in a test tube, followed by heating, a brown gas (A) was evolved. This gas intensified, when copper turnings were added to this test tube. On cooling, the gas (A) changes to a colourless gas (B).
- (a) Identify the gases A and B.
 (b) Write down the equations for the reactions involved.
- CBSE-2019
9. Give reasons for the following:
 (a) O – O single bond is weaker than S – S single bond.
 (b) Tendency to show – 3 oxidation state decreases from Nitrogen (N) to Bismuth (Bi).
 (c) Cl_2 acts as a bleaching agent.
- CBSE-2019
10. Give reasons for the following :
 (a) Dioxygen is a gas but sulphur a solid.
 (b) NO (g) released by jet aeroplanes is slowly depleting the ozone layer.
 (c) Interhalogens are more reactive than pure halogens.
- CBSE-2019
11. Give reasons:
 (i) Thermal stability decreases from H_2O to H_2Te .
 (ii) Fluoride ion has higher hydration enthalpy than chloride ion.
 (iii) Nitrogen does not form pentahalide.
- Delhi 2017
12. Give reasons:
 (i) SO_2 is reducing while TeO_2 is an oxidizing agent.
 (ii) Nitrogen does not form pentahalides.
 (iii) ICl is more reactive than I_2 .
- All India 2016
13. (i) Elements of group 16 generally show lower value of first ionisation enthalpy compared to the corresponding periods of group 15. Why?
 (ii) What happens when
 (a) concentrated H_2SO_4 is added to CaF_2 ?
 (b) sulphur dioxide reacts with chlorine in the presence of charcoal?
 (c) ammonium chloride is treated with $Ca(OH)_2$?
- All India 2015C
14. (i) How is ammonia prepared on a large scale? Name the process and mention the optimum conditions for the production of ammonia by this process.
 (ii) Assign reasons for the following:
 (a) H_2S is more acidic than H_2O .
 (b) NH_3 is more basic than PH_3 .
 (c) Sulphur has a greater tendency for catenation than oxygen.
- All India 2014C
15. Explain the trends in property in Group-16 as given under–
 (a) Ionization Enthalpy
 (b) Oxidation State
 (c) Electron Negativity
- Uttarakhand Board-2020

35. Explain anomalous behaviour of oxygen in group 16 with respect to :
 (i) Atomicity
 (ii) Magnetic property
 (iii) Oxidation state
 Maharashtra board-2023
36. Give the balanced equations for the conversion of argentite (Ag_2S) to metallic silver.
 ISC Board-2017
37. Give balanced equations for the following reactions:
 (iii) Ozone is treated with potassium iodide solution
38. Discuss the theory involved in the manufacture of sulphuric acid by contact process.
 ISC Board-2017
39. Explain why high pressure is required in the manufacture of sulphur trioxide by contact process. State the law or principle used.
 ISC Board-2017
40. Name an aerosol that depletes ozone.
 Assam Board-2014
41. Why is H_2O a liquid and H_2S a gas?
 Haryana Board-2017
 Rajasthan Board-2018
 Rajasthan Board-2020
42. Discuss the anomalous behavior of oxygen.
 Haryana Board-2017
43. Some elements in p-block shows allotropy.
 (a) What are the allotropic forms of sulphur?
 (b) (i) How will you manufacture Sulphuric Acid by contacts process?
 (ii) What are inter halogen compounds?
 Kerala Board-2015
44. (a) Name two oxoacids of sulphur.
 (b) (i) How will you manufacture ammonia by Haber process?
 (ii) Write any two uses of inert gases.
 Kerala Board-2015
45. Explain the Anamalous properties of Oxygen.
 Haryana Board-2018
46. H_2O , H_2S , H_2Te and H_2Se arrange these in increasing their acidic character.
 Haryana Board-2018
47. Write general electronic configuration of elements of group-16.
 Rajasthan Board-2020
48. Molecular formula of oxygen is O_2 while sulphur is S_8 why?
 Rajasthan Board-2018
49. When Ammonia react with atmospheric oxygen in the presence of catalyst.
 Rajasthan Board-2017
50. When sulphuric acid react with sulphur trioxide.
 Rajasthan Board-2017
51. Write the chemical formulae of four oxy acids of sulphur.
 Rajasthan Board-2014
- 52.(i) What is oleum? Write any three uses of sulphuric acid.
 (ii) At room temperature O_2 is a gas but S_8 is a solid. Why?
 Rajasthan Board-2011
53. Write rate determining step of mechanism and order of reaction for the reactions
 $\text{S}_2\text{O}_8^{2-} + 2\text{I}^- \rightarrow 2\text{SO}_4^{2-} + \text{I}_2$
 Rajasthan Board-2010
54. Explain the following:
 (a) H_2S is less acidic than H_2Te , why?
 Haryana Board-2016
55. H_2S acts only as reducing agent while SO_2 acts as an oxidizing as well as reducing agent. Why?
 Assam Board-2019
56. Why is H_2O a liquid and H_2S a gas at normal temperature?
 Assam Board-2018
57. Give chemical equations for the following processes:
 (i) Decomposition of ozone at 523K.
 (ii) Ozone oxidises lead sulphide to lead sulphate.
 (iii) Ozone reacts with aqueous solution of potassium iodide to liberate iodine.
 Assam Board-2017
58. (b) How does the FeO impurity present in sulphide ore of copper is removed?
 Assam Board-2016
59. Give reasons for the following:
 (ii) Sulphur vapour is paramagnetic.
 Assam Board-2015
60. H_2S acts only as reducing agent while SO_2 acts as an oxidising as well as reducing agent. Why?
 Assam Board-2013
61. Given reasons:
 (a) The bond dissociation energy of F_2 is less than that of Cl_2 .
 (b) Concentrated nitric acid renders aluminum passive.
 (c) Draw the structure of XeOF_4 .
 (d) Complete the following chemical reaction equation :
 (i) $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \longrightarrow$
 (ii) $\text{I}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{O}_3(\text{g}) \longrightarrow$
 Assam Board-2012
62. Oxygen exhibits oxidation states -2 to +2 while other elements of this group exhibit oxidation states +2, +4 and +6, why?
 MP Board-2018
63. Why is sky blue in colour?
 MP Board-2017
64. Describe Brodie's ozonizer with diagram
 MP Board-2013
65. Give reason for the following :
 (a) O_3 acts as a powerful oxidizing agent.
 (b) O_2 is a gas but sulphur is a solid.
 Meghalaya Board-2019

66. **OF₂** should be called oxygen difluoride and not fluorine oxide. Why ?
 (d) H₂S acts only as a reducing agent but SO₂ acts both as a reducing agent as well as an oxidizing agent. Why ?
 Meghalaya Board-2018
67. (a) Explain why thionyl chloride (SOCl₂) method is preferred for preparing alkyl chlorides from alcohols.
 (b) For isomeric haloalkanes, the boiling point decreases with branching of chain. Why?
 Meghalaya Board-2018
- Section-D : Case Based Study**
1. Write formulae of names and structures of five oxy acids of phosphorous.
 MP Board 2020
2. What happens when Sulphur dioxide reacts with acidic potassium permanganate ? Write balanced chemical equation for this reaction
 UP Board 2023
3. (a) Give reasons for the following :
 (i) Sulphur in vapour state shows paramagnetic behaviour.
 (ii) N-N bond is weaker than P-P bond.
 (iii) Ozone is thermodynamically less stable than oxygen.
 (b) Write the name of gas released when Cu is added to
 (i) dilute HNO₃ and
 (ii) conc. HNO₃
 CBSE-2019
4. (a) Draw the structure of the following :
 (i) HClO₃
 (ii) H₂S₂O₈
 (b) Give reasons for the following:
 (i) Above 1000 K sulphur shows paramagnetism.
 (ii) Although electron gain enthalpy of fluorine is less negative than that of chlorine, yet fluorine is a better oxidising agent than chlorine.
 (iii) In solid state PCl₅ exists as an ionic compound.
 CBSE-2019
- Section-E : Long Answer**
1. Essay Type Questions
 (i) Write structural formula of pyrophosphoric acid and cyclo trimetaphosphoric acid.
 (ii) Write any two differences between rhombic sulphur and monoclinic sulphur.
 (OR)
 (i) Write structural formula of peroxodisulphuric acid and pyrosulphuric acid.
 (ii) Write any two differences between white phosphorus and red phosphorus.
 Rajasthan Board 2023
2. (a) Among the hydrides of group 16, write the hydride
 (i) Which is a strong reducing agent.
 (ii) Which has maximum bond angle.
 (iii) Which is most thermally stable.
 Given suitable reason in each.
 (b) Complete the following equations :
 $S + H_2SO_4 \rightarrow$
 (Conc.)
 $Cl_2 + NaOH \rightarrow$
 (Cold and dilute)
- CBSE-2020
3. (i) Arrange the following in the order of property indicated for each set with reason:
 (I) HF, HCl, HBr, HI → decreasing acidic strength
 (II) NH₃, PH₃, AsH₃, SbH₃, BiH₃ → increasing bond angle
 (III) H₂O, H₂S, H₂Se, H₂Te → increasing acidic strength
 (ii) Why are halogens
 (I) coloured in nature; and
 (II) strong oxidizing agents?
- CBSE-2021
4. (a) Draw structure and name the shape of the following:
 (i) SF₄
 (ii) ICl₃
 (b) What happens when (Support your answer with equation)
 (i) Chlorine gas is passed through hot and concentrated sodium hydroxide solution?
 (ii) Xenon hexafluoride is subjected to complete hydrolysis?
 (iii) Concentrated sulphuric acid is poured over cane sugar?
- CBSE-2019
5. Answer the following :
 (a) Arrange the following hydrides of Group 16 elements in the decreasing order of their acidic strength : H₂O, H₂S, H₂Se, H₂Te
 (b) Which one of PCl₄⁺ and PCl₄⁻ is not likely to exist and why?
 (c) Which allotrope of sulphur is thermally stable at room temperature?
 (d) Write the formula of a compound of phosphorus which is obtained when conc. HNO₃ oxidises P₄.
 (e) Why does PCl₃ fume in moisture?
- CBSE-2019
6. (i) Draw the structures of the following:
 (a) H₂S₂O₈ (b) Red P₄
 (ii) Account for the following:
 (a) Sulphur in vapour state exhibits paramagnetism

F. Halogen Family (Group 17-Elements)

Section-A : Multiple Choice Questions

- 1. Which catalyst is used in Deacon's process for manufacture of chlorine?**

(a) CrO_3 (b) CuCl_2
(c) ZnCl_2 (d) Sn/HCl

Gujarat Borad-2022 (July)

Ans. (b)

2. The compound having highest carbon-halogen ($\text{C}-\text{X}$) bond length is—

(a) CH_3-F (b) CH_3-Cl
(c) CH_3-Br (d) CH_3-I

Rajasthan Board 2022

Ans. (a)

**3. Assertion (A) : F_2 is a strong oxidising agent.
Reason (R) : Electron gain enthalpy of fluorine is less negative.**

(a) Both Assertion (A) and Reason (R) are correct statements, and
Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are correct statements, but
Reason (R) is not the correct explanation of the Assertion (A).

20. Halogens are strong agents because of their high
ISC Board-2010
21. To which class of compounds does IF_7 belong? What is the structure of the molecule?
ISC Board-2010
22. Write balanced equation for the following reaction:
Bromine water and sodium sulphite.
ISC Board-2004, 2008
23. Write balanced equation for the following reaction:
Sodium thiosulphate and iodine solution and mixed.
ISC Board-2000, 2003
24. CaOCl_2 acts as a agent because of its properties
ISC Board-2002
25. Write balanced equation for the following:
Fluorine passed through a concentrated solution of sodium hydroxide.
ISC Board-2002
26. Write balanced equation for the following:
Bromine passed through a dilute solution of sodium hydroxide
ISC Board-2002
27. Write balanced equation for the following reaction:
Iodine with hot concentrated sodium hydroxide
ISC Board-2000
28. Write the formula and the structures of noble gas species (one each) which are isostructural with
(i) ICl_4^- (ii) BrO_3^-
Delhi 2010C, 2009C
29. Complete the following chemical reaction equation:
(i) $\text{KClO}_3 \xrightarrow[\text{MnO}_2]{\text{Heat}}$
(ii) $\text{XeF}_4 + \text{H}_2\text{O} \rightarrow$
All India 2014C
30. How are interhalogen compound formed? What general compositions can be assigned to them?
All India 2013
31. Which neutral molecule would be isoelectronic with ClO^- ?
All India 2008, 2008C
32. Give one use of ClF_3 .
Delhi 2008C
33. How are interhalogen compounds formulated and how are they prepared?
All India 2008C
34. Fluorine exhibits only – 1 oxidation state in its compounds whereas other halogens exhibit many other oxidation states. Why?
All India 2008C
35. Draw the structures of the following:
(i) H_2SO_3 (ii) HClO_3
All India 2017
36. Arrange the following in the order of property indicated against each set.
(i) HF, HCl, HBr, HI (increasing bond dissociation enthalpy)
(ii) H_2O , H_2S , H_2Se , H_2Te (increasing acidic character)
All India 2014
37. Arrange the following in the order of increasing oxidizing power:
 HClO_4 , HClO , HClO_2 , HClO_3
Delhi 2010, 2009C
38. Why are pentahalides of a metal more covalent than its trihalides?
All India 2010
39. Arrange the following in the order of increasing acidic strength.
 HCl , HBr , HI , HF
Delhi 2010, 2009C
40. Hydrogen fluoride has a much higher boiling point than hydrogen chloride. Why?
All India 2009
41. Complete the following reaction:
 $\text{F}_2 + \text{H}_2\text{O} \rightarrow$
Foreign 2009; Delhi 2008
42. Give reason: Hydrogen iodide is a stronger acid than hydrogen fluoride in aqueous solution.
All India 2009C
43. Complete the following reaction:
 $\text{I}_2 + \text{NaClO}_3 \rightarrow$
All India 2009C
44. Predict the shape and the asked angle (90° or more or less) in the following case: ClF_3 and the angle: F — Cl — F
Delhi 2012
45. Why is ICl more reactive than I_2 ?
All India 2012, 2011C, 2010C, 2009
46. Despite lower value of its electron gain enthalpy with negative sign, fluorine, F_2 is a stronger oxidizing agent than Cl_2 .
All India 2012
47. The halogens are coloured, why?
All India 2012, 2010C
48. Draw the structure of ClF_3 molecule.
All India 2012, 2008
49. Draw the structure of HClO_4 .
All India 2012, 2009;
Delhi 2011; Foreign 2010
50. Complete the following reaction equation:
 NaOH (hot and conc.) + $\text{Cl}_2 \rightarrow$
Delhi 2012, 2011, 2010, 2009C;
All India 2011C, 2009C; Foreign 2009
51. Despite having greater polarity, hydrogen fluoride boils at a lower temperature than water.
All India 2012
52. Complete the following chemical equation:
 $\text{Cl}_2 + \text{F}_2$ (excess) \rightarrow
Delhi 2012, 2011; foreign 2011

53. Account for the following:
Chlorine water loses its yellow colour on standing.
All India 2012C
54. F_2 is most reactive of all the four common halogens. Explain.
Delhi 2011
55. What happens when chlorine gas is passed through a hot conc. solution of NaOH?
All India 2011; foreign 2011;
Delhi 2010C, 2008C
56. Why does fluorine not play the role of a central atom in interhalogen compounds?
All India 2011
57. How would you account for the following? The oxidizing power of oxoacids of chlorine follows the order
 $HClO_4 < HClO_3 < HClO_2 < HClO$
Foreign 2011; Delhi 2008C
58. Complete the following chemical equation:
 $Br_2 + F_2$ (excess) \rightarrow
Foreign 2011
59. Explain in aqueous medium, HCl is stronger acid than HF.
Foreign 2011
60. Draw the structure of $HOClO_2$ molecule.
All India 2011C, 2009
61. Complete the following reaction:
 $I_2 + H_2O + Cl_2 \rightarrow$
All India 2011C
62. Electron gain enthalpy with negative sign for fluorine is less than that for chlorine.
All India 2011, 2008
63. Arrange F_2 , Cl_2 , Br_2 and I_2 in the order of increasing bond dissociation enthalpy.
Delhi 2011C
64. Fluorine forms the largest number of interhalogen compounds amongst the halogens.
Delhi 2011C, 2010C, 2009C
65. How would you account for the order of increase in strength of acids?
 $PH_3 < H_2S < HCl$
Foreign 2011
66. Halogens are strong oxidizing agents. Why?
Delhi 2010C
67. CIF_3 molecule has a T-shaped structure and not a trigonal planar one. Explain why?
Delhi 2010
68. Which is stronger acid in aqueous solution, HCl or HI and why?
Foreign 2010; All India 2009
69. Account for the following: HF is not stored in glass bottles but is kept in wax-coated bottles?
All India 2013C
70. F_2 is a stronger oxidizing agent than Cl_2 . Why?
2014C, Delhi 2011; Foreign 2010,
2009; All India 2009
71. Name two poisonous gases which can be prepared from chlorine gas.
All India 2013
72. Give reason for the following:
Fluorine does not exhibit any positive oxidation state.
Delhi 2013, All India 2012;
Delhi 2009; foreign 2009
73. Draw the structure of BrF_3 molecule.
Delhi 2013, Delhi 2011, 2010, 2009, 2008C;
All India 2011, 2009; foreign 2010, 2009
74. Give reason for the following:
 F_2 is more reactive than CIF_3 but CIF_3 is more reactive than Cl_2 .
Delhi 2013C
75. Bond enthalpy of F_2 is less than that of Cl_2 . Why?
Delhi 2013, 2009; All India 2009
76. Complete the following chemical equation:
 $I_2 + HNO_3$ (conc.) \rightarrow
Delhi 2011
77. Write the formula of the compound of iodine which is obtained when conc. HNO_3 oxidises I_2 .
All India 2017
78. What happens when Cl_2 reacts with dry slaked lime?
Telangana Board-2023
79. Concentrated hydrogen fluoride exists in the molecular formula of _____.
Odisha Board-2017
80. Why is electron affinity of chlorine greater than that of fluorine?
Odisha Board-2020
81. Why electron affinity of fluorine is less than that of chlorine?
Tamil Nadu Board-2015
82. Why HF cannot be stored in glass bottles?
Tamil Nadu Board-2011
83. (a) What happens when XeF_4 reacts with SbF_5 ? Write the chemical equation of the reaction.
(b) Draw structure of $XeOF_4$
NIOS Board-2018
84. Account for the following:
a) $HOClO_3$ is the strongest acid among the oxoacids of chlorine.
b) HF is liquid at room temperature whereas HCl, HBr and HI are gases.
NIOS Board-2021
85. How is chlorine manufactured by Deacon's Method?
Andhra Pradesh Board-2019
86. is the most Electronegative element in periodic table.
Haryana Board-2022
87. Complete the following reactions:
(a) $XeF_4 + O_2F_2 \rightarrow$
(b) $Ca(OH)_2 + Cl_2 \rightarrow$
Goa Board-2018
88. Explain why fluorine shows an anomalous behavior.
J&K Board-2019

89. In aryl halides what is the hybridisation of carbon atom to which halogen is attached?
Karnataka Board-2018
90. Halogens are strong oxidizing agent, why?
Chhattisgarh Board-2021
91. Account for the following:
 (i) Halogens are coloured.
 (ii) Noble gases have very low boiling points.
Assam Board-2014
92. What is tincture of iodine? What is its use :
Jharkhand Board-2020
93. On the basis of VSEPR theory deduce the geometry of XeF_2 .
Manipur Board-2019
94. Write the equations for reactions of chlorine with the following
 (a) Cold and dilute NaOH
 (b) Excess NH_3
 (c) $\text{Ca}(\text{OH})_2$
 (d) $\text{Na}_2\text{S}_2\text{O}_3$
Andhra Pradesh Board-2018
95. Why is the highest oxidation state of a metal exhibited in its oxide or fluoride only?
Rajasthan Board-2014
96. Write the molecular formula of explosive in which iodine is used in the manufacturing.
Rajasthan Board-2010
97. The ionization energy of fluorine is greater than oxygen. Why?
Tamilnadu Board, Sep.-2016
98. Calculate the effective nuclear charge of the last electron in an atom whose configuration is $1s^2 2s^2 2p^6 3s^2 3p^5$.
Tamilnadu Board, March-2016
99. Give reasons:
 (ii) Halogens are coloured.
Assam Board-2020
100. (a) Complete the following chemical reaction equations:
 (i) $\text{F}_2(\text{g}) + \text{H}_2\text{O} (\text{l}) \rightarrow ?$
 (ii) $\text{Ca}_3\text{P}_2 (\text{s}) + \text{H}_2\text{O} (\text{l}) \rightarrow ?$
 (iii) $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \rightarrow ?$
 (b) Draw the structure of the following molecules and mention their shapes:
 (i) XeF_4
 (ii) ClF_3
Assam Board-2013
101. Explain the bleaching action of Cl_2 .
Assam Board-2013
102. (a) Write chemical equation for the following processes:
 (i) Chlorine is passed through hot and concentrated solution of sodium hydroxide.
 (ii) Orthophosphorous acid is heated.
 (b) Mention two uses of H_2SO_4
Assam Board-2012
103. What is the composition of tincture of iodine?
Assam Board-2012
104. All Halogens are strong oxidising agents. Why?
MP Board-2018
105. What are interhalogen compounds.
MP Board-2016
106. Elements of group 17 are generally known as
MP Board-2015
107. Fluorine always shows -1 oxidation state. Why?
MP Board-2014
108. Write the name of radioactive halogen?
MP Board-2014
109. Why dry chlorine does not act as a bleaching agent?
Meghalaya Board-2021
110. Which is the most electronegative element in periodic table?
Jharkhand Board-2023

Section-C : Short Answer

1. Why are interhalogen compounds more reactive than the halogens (except fluorine)? Write the products formed when ClF undergoes hydrolysis
Manipur Board 2023
2. Complete the following chemical reactions:
 (a) $\text{MnO}_2 + 4 \text{HCl} \rightarrow$
 (b) $\text{XeF}_6 + \text{KF} \rightarrow$
 (c) $\text{I}^- (\text{aq}) + \text{H}^+ (\text{aq}) + \text{O}_2 (\text{g}) \rightarrow$
CBSE-2020
3. Account for the following
 (a) Interhalogen compounds are more reactive than pure halogens.
 (b) Nitrogen is less reactive at room temperature
 (c) Reducing character increases from NH_3 to
CBSE-2019
4. Account for the following:
 (i) PCl_5 is more covalent than PCl_3 .
 (ii) Iron on reaction with HCl forms FeCl_2 and not FeCl_3 .
 (iii) The two O—O bond lengths in the ozone molecule are equal.
All India 2014
5. (a) Draw the structure of any one of the following:
 (i) Chlorous acid
 (ii) S_8
 (b) Answer the following questions: (any two)
 (i) Are the bond lengths of all five P—Cl bonds in PCl_5 molecule equal? Justify your answer.
 (ii) Explain why HNO_2 behaves both as oxidizing as well as reducing agent.
 (iii) When HCl reacts with finely powdered iron, it forms ferrous chloride, and not ferric chloride. Explain, why?
Assam Board-2022

6. (b) Why are halogens coloured?
Uttarakhand Board-2020
7. (c) Write the reaction of Cl_2 with water.
Uttarakhand Board-2020
8. Write any two anomalous properties of Fluorine.
State the geometry of :
(a) XeF_4 and
(b) XeF_6
Goa Board-2023
9. (a) How do electronegativity values help to find out the nature of bonding between atoms?
Tamil Nadu Board-2011
10. This element 'X' belongs to group 17 of the modern periodic table. It is found in the mineral cryolite and cannot be prepared by the oxidation of its anion, X^- . Why is the HX liquid at room temperature whereas all other hydrohalic acids are gases ? Explain with the help of a figure.
NIOS Board-2022
11. Complete the following equations:
 i) $2\text{Al} + 3\text{Cl}_2 \longrightarrow$
 ii) $\text{H}_2\text{S} + \text{Cl}_2 \longrightarrow$
 iii) $8\text{NH}_3 + 3\text{Cl}_2 \xrightarrow{\text{(excess)}} \text{_____}$
Karnataka Board-2014
12. a) Complete the following reaction.
 i) $\text{NH}_3 + 3\text{Cl}_2 \rightarrow \text{_____} + \text{HCl}$
 ii) $\text{Cl}_2 + \text{F}_2 \xrightarrow{473\text{K}} \text{_____}$
 b) Write the structure of perchloric acid (HClO_4).
Karnataka Board-2020
13. a) How is chlorine prepared using KMnO_4 ?
 b) Why is I_2 less reactive than ICl ?
Karnataka Board-2016
14. a) Which is the strongest acid among the hydrogen halides? Give one reason ($\text{X} = \text{F}, \text{Cl}, \text{Br}$ and I).
 b) Write the structure of chloric acid (HClO_3).
3
Karnataka Board-2015
15. (a) Explain the various factors that affect electron affinity
Tamil Nadu Board-2018
16. Which of the halogen hydrides forms bi-salt ? Write reasons.
West Bengal Board-2019
17. (i) Why are interhalogen compounds more reactive than halogens ?
 (ii) All the five bonds in PCl_5 are not equivalent. Justify
Punjab Board-2017
18. a) Among HF and HI, which is more stable?
 b) Name the Oxo acid of Fluorine.
 c) Why is ICl more reactive than I_2 ?
Karnataka Board-2020
19. a) Complete the reaction
 $\text{Cl}_2 + 2\text{H}_2\text{O} + \text{SO}_2 \longrightarrow$
 b) i) Which halogen has highest electron affinity or electron gain enthalpy ?
 ii) Give the structure of perchloric acid. (1 + 2)
Karnataka Board-2015
20. a) How does hot and concentrated Sodium hydroxide reacts with chlorine? Write equation.
 b) How does electronegativity of Halogens vary down the group?
Karnataka Board-2016
21. Given reason:
 i) ICl is more reactive than I_2 ,
 ii) Fluorine exhibit only -1 oxidation state.
 iii) H-F is liquid but other hydrogen halides are gases.
Karnataka Board-2017
22. a) Give any two reasons for anomalous behaviour of Fluorine.
 b) Write the structure of perchloric acid (HClO_4).
Karnataka Board-2019
23. Write chemical composition of haematite. Write the names and electronic configurations of first two elements of group 17.
Maharashtra board-2022
24. Explain the following properties of elements of 17th group :
 (a) Oxidation state
 (b) Electronegativity
Chhattisgarh Board-2022
25. (i) Give the preparation and structure of XeF_2
 (ii) Which of the following does not exist:
 (A) XeOF_4 (B) XeF_4
 (C) XeO_3 (D) NeF_2
 (iii) Why ICl is more reactive than I_2 ?
Kerala Board-2021
26. Complete the following :
 (a) $\text{XeF}_2 + \text{H}_2 \rightarrow$
 (b) $\text{XeF}_6 + 3\text{H}_2\text{O} \rightarrow$
Jharkhand Board-2019
27. Answer the following :
 (i) Fluorine forms only one oxoacid HOF . Write the reason.
 (ii) Draw the structure of XeOF_4 .
Goa Board-2019
28. (i) What are the types of hybridization of iodine in interhalogen compounds IF_3 , IF_5 and IF_7 , respectively?
ISC Board-2017
29. Explain the following properties of elements of 17th group:
 (a) Oxidation state
 (b) Electronegativity
Chhattisgarh Board-2020

30. Complete the following chemical equation:
 (i) $\text{KClO}_3 \xrightarrow[\text{MnO}_2]{\Delta} ?$
 (ii) $\text{Al}_2\text{O}_3(\text{s}) + 6\text{HCl}(\text{aq}) + 9\text{H}_2\text{O}(\text{l}) \rightarrow ?$
 Assam Board-2014
31. What are interhalogen compounds?
 Assam Board-2014
32. Arrange the following in order of decreasing bond dissociation enthalpy
 $\text{HI}, \text{HF}, \text{HBr}, \text{HCl}$.
 Assam Board-2014
33. Complete the following :
 (a) $\text{Br}_2 + \text{NaI} \rightarrow$
 (b) $\text{CaF}_2 + \text{H}_2\text{SO}_4 \rightarrow$
 (c) $\text{NH}_4\text{Cl}(\text{aq}) + \text{NaNO}_2(\text{aa}) \rightarrow$
 Jharkhand Board-2020
34. Why does PCl_3 fumes in moisture?
 Haryana Board-2017
35. Explain the trends in property in halogen family as given under— [3]
 (i) Ionisation Energy
 (ii) Oxidation States
 (iii) Electron Affinity
 Uttarakhand Board-2019
36. How is chlorine prepared in laboratory? How does it react with the following.
 (a) Cold, Dil, NaOH
 (b) Hot, Conc, NaOH
 (c) NH_3 (excess)
 (d) NH_3 with excess Cl_2
 Andhra Pradesh Board-2021
37. Why the value of electron gain enthalpy of chlorine is higher than fluorine? Explain.
 Rajasthan Board-2020
38. Explain with chemical equation—what happens when slacked lime reacts with chlorine?
 Rajasthan Board-2018
39. Write the general electronic configuration of chalcogen group. Write the chemical formula of epsom salt.
 Rajasthan Board-2014
40. Write the chemical formulae of four oxy acids of chlorine.
 Rajasthan Board-2014
41. (i) What are inter-halogen compounds? Write the molecular formulae of all known oxyacids of Bromine.
 (ii) At room temperature Cl_2 is a gas, but Br_2 is a liquid and I_2 is a solid. Why?
 (iii) C-Cl bond is polar in nature but C-Cl₄ is non-polar. Explain with reason.
 Rajasthan Board-2011
- 42.(a) Explain the variation of ionization energy along the group and period.
 Tamilnadu Board, March-2016
43. (ii) How can you prepare Cl_2 from HCl and HCl from Cl_2 ? Write reactions only.
 Assam Board-2020
44. Give the reaction of dichlorine gas with cold & dilute and hot and concentrated $\text{NaOH}_{(\text{aq})}$.
 Gujarat Board-2018
45. (b) Anomalous behaviour of Fluorine
 Haryana Board-2016
46. What are interhalogen compounds?
 Assam Board-2018
47. What happens when potassium chlorate is heated with manganese dioxide?
 Assam Board-2018
48. Give reasons for the following :
 (iv) In the reaction between HCl and powdered iron, ferric chloride is not formed.
 Assam Board-2017
49. Give reasons for the following :
 (i) Bleaching by chlorine is permanent, while that by sulphur dioxide is temporary.
 Assam Board-2017
50. Complete the following reactions:
 (i) NaOH (hot, conc) + $\text{Cl}_2(\text{g}) \rightarrow$
 (ii) NH_3 (excess) + $\text{Cl}_2 \rightarrow$
 Assam Board-2016
51. Give reasons for the following:
 (iii) Moist chlorine is powerful bleaching agent.
 Assam Board-2015
52. (a) Bleaching of flowers by chlorine is stable but bleaching of SO_2 is unstable. Why?
 (b) Water is liquid while hydrogen sulphide is a gas at normal temperature. Why?
 MP Board-2016
53. Why the elements of group 17 are coloured?
 MP Board-2015
54. Bleaching of flowers by Cl_2 is permanent while bleaching by SO_2 is temporary. Why?
 MP Board-2013
55. Fluorine shows only +1, -1 oxidation state while other halogen element shows +3, +5 and +7 oxidation states in addition to +1, -1 why?
 MP Board-2012
56. a. (i) How are XeF_6 and XeO_3 prepared?
 (ii) Draw the structure of XeF_2 , XeF_4 and XeOF_4 .
 OR
 b. (i) Explain the thermal stability of hydrides of gr-15 elements.
 (ii) List three oxoacids of halogens in their different oxidation state.
 Nagaland Board-2020
57. (i) What are interhalogen compounds? How are they prepared?
 (ii) Draw the structure of IF_7 and BrF_5 and mention its type of hybridization.
 Nagaland Board-2021

Section-D : Case Based Study

1. Read the given passage and answer the questions 1 to 5 that follow :
 The halogens have the smallest atomic radii in their respective periods. The atomic radius of fluorine is extremely small. All halogens exhibit – 1 oxidation state. They are strong oxidising agents and have maximum negative electron

gain enthalpy. Among halogens, fluorine shows anomalous behaviour in many properties. For example electro negativity and ionisation enthalpy are higher for fluorine than expected whereas bond dissociation enthalpy, m.p. and b.p. and electron gain enthalpy are quite lower than expected. Halogens react with hydrogen to give hydrogen halides (HX) and combine amongst themselves to form a number of compounds of the type XX' , XX'_3 , XX'_5 and XX'_7 called inter-halogens.

1. Why halogens have maximum negative electron gain enthalpy ? CBSE-2020
2. Why fluorine shows anomalous behavior as compared to other halogens ? CBSE-2020
3. Arrange the hydrogen halides (HF to HI) in the decreasing order of their reducing character. CBSE-2020
4. Why fluorine is a stronger oxidizing agent than chlorine ? CBSE-2020
5. What are the sizes of X and X' in the interhalogen compounds ? CBSE-2020

Section-E : Long Answer

1. (a) Account for the following :
 - (i) Tendency to show -2 oxidation state decreases from oxygen to tellurium.
 - (ii) Acidic character increases from HF to HI
 - (iii) Moist SO_2 gas acts as a reducing agent.
 - (b) Draw the structure of an oxoacid of sulphur containing $\text{S}-\text{O}-\text{S}$ linkage.
 - (c) Complete the following equation :

$$\text{XeF}_2 + \text{H}_2\text{O} \rightarrow$$
CBSE-2020
2. (a) Account for the following :
 - (i) Hydration enthalpy of F^- ion is more than Cl^- ion.
 - (ii) SO_2 is a reducing agent, whereas TeO_2 is an oxidising agent in group-16 oxides.
 - (b) Write the reaction of F_2 with water. Why does I_2 not react with water ?
 - (c) Draw the structure of XeF_2 . CBSE-2020
3. (a) Give reasons for the following observations:
 - (i) Halogens are strong oxidising agents.
 - (ii) Noble gases have very low boiling points.
 - (iii) O and Cl have nearly same electronegativity, yet oxygen forms H bond while Cl doesn't.
 (b) Complete and balance the following chemical equations :
 - (i) $\text{NaOH} + \text{Cl}_2 \rightarrow$
(cold + dil.)
 - (ii) $\text{I}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{O}_3(\text{g}) \rightarrow$CBSE-2020

4. (a) (i) Account for the following:
 - (a) Tendency to show -2 oxidation state decreases from Oxygen to Polonium in Group - 16
 - (b) Among the noble gases, only Xenon is known to form chemical compounds.
 - (c) Axial $\text{Br} - \text{F}$ bonds are slightly bent in the structure of BrF_3 .
 - (ii) Draw the structures of XeF_6 and XeF_2CBSE-2021
5. (B) Write the reaction of Cl_2 with the following :

(i) H_2S	(ii) I_2
(iii) $\text{Ca}(\text{OH})_2$	(iv) H_2O

Telangana Board-2017
6. (i) Write the formula and describe the structure of a noble gas species which is isostructural with

(a) IBr_2^-	(b) BrO_3^-
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 (ii) Assign reasons for the following:
 - (a) SF_6 is kinetically inert
 - (b) NF_3 is an exothermic compound whereas NCl_3 is not
 - (c) HCl is a stronger acid than HF though fluorine is more electronegative than chlorine.All India 2014
7. (i) Complete the following chemical equation:
 - (a) $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \rightarrow$
 - (b) $\text{XeF}_4 + \text{O}_2\text{F}_2 \rightarrow$
 - (ii) How would you account for following situations?
 - (a) The acidic strength of these compounds increases in the following order
 $\text{PH}_3 < \text{H}_2\text{S} < \text{HCl}$
 - (b) The oxidizing power of oxoacids of chlorine follows the order
 $\text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2 < \text{HClO}$
 - (c) In vapour state, sulphur exhibits paramagnetic behaviour.
8. (i) Draw the structures of the following:

(a) XeF_4	(b) $\text{H}_2\text{S}_2\text{O}_7$
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 (ii) Account for the following:
 - (a) Iron on reaction with HCl forms FeCl_2 and not FeCl_3 .
 - (b) HClO_4 is a stronger acid than HClO .
 - (c) BiH_3 is the strongest reducing agent amongst all the hydrides of group 15.Foreign 2015
9. (i) Account for the following:
 - (a) Acidic character increases from HF to HI .
 - (b) There is large difference between the melting and boiling points of oxygen and sulphur.
 - (c) Nitrogen does not form pentahalide.
 - (ii) Draw the structure of the following:

(a) ClF_3	(b) XeF_4
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- 30.(a) (i) How is XeF_4 prepared ?
(ii) Mention the types of hybridization of Xe in XeF_4 and XeOF_4 . Draw their structures.

Nagaland Board-2018

31. (i) What are Inter-halogen compounds ? How are they classified?
(ii) Draw the structure of ClF_3 , BrF_5 and IF_7 and mention the type of hybridization and geometry in each case.

Nagaland Board-2017

32. (a) F-atom is more electronegative than I-atom, yet HF has lower acid strength than HI. Why ?
(b) Explain why oxygen is a gas while other members of the same group are solids.
(c) For interhalogens of the type AX_n (A, X = halogen atoms; n = 1 or 3 or 5 or 7), what relation exists between A and X ? How does their reactivity vary with individual halogens?
(d) Why does NO_2 dimerize ?
(e) Draw the structure of $\text{H}_2\text{S}_2\text{O}_7$. What is the oxidation state of sulphur in it ?
(f) Write the balanced chemical equations of the following :
(i) Excess of ammonia with chlorine
(ii) Conc. H_2SO_4 with calcium fluoride

Meghalaya Board-2018

G. Noble Family (Group 18-Elements)

Section-A : Multiple Choice Questions

1. How many lone pair of electron is present on Xe in XeO_3 ?
(a) 0 (b) 2
(c) 1 (d) 3

Gujarat Board 2023 (March)

- Ans. (c)
2. What is geometric shape of XeF_4 ?
(a) Distorted octahedral (b) Square pyramidal
(c) Trigonal bipyramidal (d) Pyramidal

Gujarat Board 2022 (July)

- Ans. (b)
3. What is the electronic configuration of Cr?
(a) $[\text{Cr}]3\text{d}^4 4\text{s}^2$ (b) $[\text{Cr}]3\text{d}^5 4\text{s}^1$
(c) $[\text{Cr}]3\text{d}^5 4\text{s}^0$ (d) $[\text{Cr}]3\text{d}^4 4\text{s}^0$

Gujarat Board-2021

- Ans. (b)
4. Which of the following compounds has square planar structure?
(a) XeF_4 (b) XeF_2
(c) XeF_6 (d) XeOF_4

Gujarat Board-2021

- Ans. (a)
5. XeF_4 and XeF_6 are expected to be:
(a) Oxidising (b) Reducing
(c) Unreactive (d) Strongly basic

Odisha Board-2017

6. Inert gas used in beacon lights for safety of air navigation is
(a) Helium
(b) Argon
(c) Neon
(d) Xenon.

Tamil Nadu Board-2011

Ans. (c)

7. The hybridization involved in XeF_6 is
(a) SP^3d^3 (b) SP^3d^2
(c) SP^3d (d) SP^3

Tamil Nadu Board-2011

Ans. (a)

8. Among the following which has the maximum ionisation energy?
(a) Alkali metals
(b) Alkaline earth metals
(c) Halogens
(d) Noble gases

Tamil Nadu Board-2011

Ans. (d)

9. The lightest gas which is non-inflammable is
(a) He (b) H_2
(c) N_2 (d) Ar.

Tamil Nadu Board-2011

Ans. (b)

10. The hybridization in XeOF_4 molecule is:
(a) sp^3
(b) sp^3d^2
(c) sp^3d
(d) sp^3d^3

Tamil Nadu Board-2016

Ans. (b)

11. What is general formula for electronic configuration of actinide series.
(a) $[\text{Rn}]5\text{f}^{0-14} 5\text{d}^{0-2} 6\text{s}^2$ (b) $[\text{Xe}]4\text{f}^{0-14} 5\text{d}^{0-10} 6\text{s}^2$
(c) $[\text{Xe}]4\text{f}^{0-4} 5\text{d}^{0-1} 6\text{s}^2$ (d) $[\text{Rn}]5\text{f}^{0-14} 6\text{d}^{0-2} 7\text{s}^2$

Gujarat Board-2019

Ans. (d)

12. Geometry of XeF_2 molecules is
(a) linear (b) trigonal pyramidal
(c) square planar (d) square pyramidal

Rajasthan Board-2010

Ans. (a) :

13. Which element has positive value of electron gain enthalpy?
(a) Ne (b) Cl
(c) N (d) O

Gujarat Board-2018

Ans. (a)

14. The geometry of XeF_6 molecule and the hybridisation of Xe atom in the molecule is
(a) distorted octahedral and sp^3d^3
(b) square planar and sp^3d^2
(c) pyramidal and sp^3
(d) octahedral and sp^3d^3

ISC Board-2015

Ans. (a)

28. Draw the structures of the following:
 (i) H_3PO_2 (ii) XeF_4
Delhi 2017
29. Complete the following of the reactions:
 (i) $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow$
 (ii) $\text{XeF}_6 + 3\text{H}_2\text{O} \rightarrow$
Delhi 2017
30. Draw the structures of the following:
 (i) $\text{H}_4\text{P}_2\text{O}_7$ (ii) XeOF_4
Delhi 2017
31. Complete the following reactions:
 (i) $\text{NH}_3 + 3\text{Cl}_2$ (excess) \rightarrow
 (ii) $\text{XeF}_6 + 2\text{H}_2\text{O} \rightarrow$
Delhi 2017
32. Draw the structures of the following:
 (i) $\text{H}_2\text{S}_2\text{O}_7$ (ii) XeF_6
Delhi 2017
33. Draw the structure of the following:
 (i) XeF_4 (ii) BrF_5
All India 2017
34. Draw the structure of XeF_2 molecule.
Delhi 2013, 2011; All India 2013,
2009C; Foreign 2012, 2010
35. Draw the structure of XeF_4 molecule.
Delhi 2013, 2011C, 2010, 2009,
2008; All India 2010, 2009C; Foreign 2009
36. Helium is used in diving equipments. Why?
Delhi 2013; foreign 2009
37. Draw the structure of XeOF_4 molecule.
All India 2013
38. What inspired N Bartlett for carrying out reaction between Xe and PtF_6^- ?
Delhi 2013
39. Draw the molecular structure of XeF_6 .
All India 2013, Delhi 2012
40. Predict the shape and the asked angle (90° or more or less) in the following case: XeF_2 and the angle F—Xe—F
Delhi 2012
41. Explain the following giving an appropriate reason:
 Structures of xenon fluorides cannot be explained by valence bond approach.
HOTS; Delhi 2012
42. Complete the following chemical equation:
 $\text{XeF}_4 + \text{SbF}_5 \rightarrow$
Delhi 2012, All India 2009
43. Complete the following chemical equations:
 $\text{XeF}_4 + \text{O}_2\text{F}_2 \xrightarrow{143\text{K}}$
All India 2012, 2009C
44. Helium forms no real chemical compound. Why?
All India 2012, 2009; foreign 2009
45. Complete the following chemical equation:
 $\text{XeF}_4 + \text{H}_2\text{O} \rightarrow$
Delhi 2011; All India 2011C, 2009
46. Why the noble gases have very low boiling points?
All India 2011
47. Complete the following chemical equation:
 $\text{XeF}_6 + \text{H}_2\text{O}$ (Excess) \rightarrow
Foreign 2011; Delhi 2012,
2010, All India 2010
48. Complete the following reaction equation:
 $\text{XeF}_2 + \text{PF}_5 \rightarrow$
All India 2011; Foreign 2009
49. XeF_2 is linear molecule without a bent. Explain.
All India 2010
50. XeF_2 has a straight linear structure and not a bent angular structure. Explain.
Delhi 2010
51. Noble gases are least reactive elements. Give reason.
Foreign 2010
52. What happens when XeF_6 is hydrolysed?
Delhi 2010, 2009C
53. The majority of known noble gas compounds are those of xenon. Give reason.
Delhi 2009
54. Of the noble gases, only xenon is known to form well established chemical compounds. Give reason.
All India 2008
55. Complete the following reaction:
 $\text{XeF}_6 + \text{KF} \rightarrow$
All India 2009C
56. Which noble gas mixed with oxygen is used by sea-divers for their respiration under water?
Odisha Board-2020
57. Give the uses of Neon.
Tamil Nadu Board-2015
58. Write the structure of XeF_4 .
Karnataka Board-2014
59. Name the noble gas having ns^2np^6 electronic configuration but does not have d-orbital's in its valence shell.
Karnataka Board-2019
60. Complete the following equation.
 $\text{XeF}_6 + \text{H}_2\text{O} \rightarrow \dots + 2\text{HF}$
Karnataka Board-2018
61. Which noble gas is most abundant in atmospheric dry air?
Karnataka Board-2017
62. Noble gases are chemically inert. Give one reason.
Karnataka Board-2016
63. Identify the product 'A' in the following reaction.
 $\text{XeF}_6 + 3\text{H}_2\text{O} \rightarrow A + 6\text{HF}$
Karnataka Board-2015
64. Give a reason for chemical inertness of Nobel gases.
Karnataka Board-2014
65. Explain what is inert pair effect. What are its causes?
NIOS Board-2013

Section-C : Short Answer

1. Noble gases are inert. Explain.
Telangana Board-2017
 2. How do xenon fluorides reacts with fluoride ion donors like NaF? Give equation.
Karnataka board 2023
 3. Give one method of preparation of XeF_4 . Mention one reaction in which it acts as an oxidizing agent. Given its structure.
Odisha Board-2017
 4. Write any three uses of neon.
Tamil Nadu Board-2018
 5. How are XeF_2 and XeF_4 prepared ? Give their structures.
Andhra Pradesh Board-2019

6.	(i) How does chlorine react with (a) acidified FeSO_4 ? (b) dry slaked lime? (ii) Describe the manufacture of H_2SO_4 by contact process. Andhra Pradesh Board-2020	20. Give two main qualities of rocket propellants. Rajasthan Board-2010
7.	Complete the following reactions : (a) $\text{XeF}_4 + \text{H}_2 \rightarrow$ (b) $\text{XeF}_4 + \text{Pt} \rightarrow$ (c) $\text{XeOF}_4 + 3\text{H}_2 \rightarrow$ Jharkhand Board-2018	21. Draw the structure of the following molecule and mention its shape: XeF_4 Assam Board-2019
8.	Draw the structure of xenon hexafluoride (XeF_6) molecule and state the hybridization of the central atom. ISC Board-2017	22. (a) Mention one use each of argon and Helium gases. (b) Name the noble gas that forms majority of the known noble gas compounds. Assam Board-2015
9.	Discuss the shape and structure of XeF_4 . Haryana Board-2017	23. Explain why ionisation energy of noble gases are highest. MP Board-2017
10.	Write any two anomalous properties of Fluorine. State the geometry of : (a) XeF_4 and (b) XeF_6 Goa Board-2019	1. Read the given passage and answer the questions number 1 to 5 that follow: In 1962, Neil Bartlett prepared a complex compound by reacting molecular oxygen and PtF_6 . Then he carried out the reaction between a noble gas and PtF_6 and obtained a red coloured compound. The noble gases have completely filled electronic configuration in their valence shell and are monoatomic under normal conditions. They possess low boiling points. The direct reaction of Xenon with Fluorine leads to a series of compounds with oxidation states + 2, + 4 and + 6. XeF_4 reacts violently with water to give XeO_3 . The geometries of compounds of Xenon can be deduced considering the total number of electron pairs in the valence shell.
11.	Complete the following reaction: $\text{XeF}_4 + \text{O}_2\text{F}_2 \xrightarrow{143k}$ Rajasthan Board-2020	1. What inspired Neil Bartlett to carry out the reaction between Xe and PtF_6 ? CBSE-2020
12.	Draw the structure of XeOF_4 . Rajasthan Board-2020	2. Out of Helium and Xenon, which one can easily form compounds and why? CBSE-2020
13.	Complete the following reaction $\text{XeF}_6 + 2\text{H}_2\text{O} \rightarrow$ Rajasthan Board-2018	3. The bond dissociation enthalpy of Fluorine is less than that of chlorine. Why? CBSE-2020
14.	Draw structure of HClO_4 . Rajasthan Board-2018	4. Write the balanced chemical equation for the hydrolysis of XeF_2 . CBSE-2020
15.	Draw structure of XeO_3 . Rajasthan Board-2018	5. Give one use of Neon. CBSE-2020
16.	Write only the types of hybridization of central atom present in XeF_2 and XeF_4 . Rajasthan Board-2017	
17.	What are clathrate compounds? Give an example. Rajasthan Board-2011	
18.	Why are He, Ne, Ar called as inert and rare gases? Rajasthan Board-2010	
19.	Write any two differences in the physical properties of Ne and Ar. Rajasthan Board-2010	

Section-D : Case Based Study

1. Read the given passage and answer the questions number 1 to 5 that follow:

In 1962, Neil Bartlett prepared a complex compound by reacting molecular oxygen and PtF_6 . Then he carried out the reaction between a noble gas and PtF_6 and obtained a red coloured compound. The noble gases have completely filled electronic configuration in their valence shell and are monoatomic under normal conditions. They possess low boiling points. The direct reaction of Xenon with Fluorine leads to a series of compounds with oxidation states + 2, + 4 and + 6. XeF_4 reacts violently with water to give XeO_3 . The geometries of compounds of Xenon can be deduced considering the total number of electron pairs in the valence shell.
 1. What inspired Neil Bartlett to carry out the reaction between Xe and PtF_6 ?

CBSE-2020
 2. Out of Helium and Xenon, which one can easily form compounds and why?

CBSE-2020
 3. The bond dissociation enthalpy of Fluorine is less than that of chlorine. Why?

CBSE-2020
 4. Write the balanced chemical equation for the hydrolysis of XeF_2 .

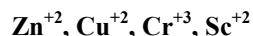
CBSE-2020
 5. Give one use of Neon.

CBSE-2020

6. Account for the following trends in atomic and ionic radii of transition metals.
- Ions of the same charge in a given series (3d, 4d or 5d) show progressive decrease in radii with increasing atomic number.
 - The atomic radii of elements in 4d series are more than that of corresponding elements in 3d series.
 - The atomic radii of the corresponding elements in '4d' series and '5d' series are virtually the same.
- Kerala Board-2013
7. Write the electronic configuration of:
- Co^{2+} (27)
 - Ce^{4+} (58)
 - Lu^{2+} (71)
- Haryana Board-2017
8. Write the electronic configuration of Ni(28), Zn(30).
- Haryana Board-2017
9. (a) Write Electronic configurations of:
- Fe^{2+}
 - Cr
 - Mn^{2+}
- Haryana Board-2018
10. Write electronic configuration of Chromium ($Z=24$).
- Rajasthan Board-2018
11. Define transition elements.
Give the general electronic configuration of the transition elements.
- Assam Board-2017
12. What are transition elements?
Give the general electronic configuration of transition elements.
- Assam Board-2015
13. Write the electronic configuration of Fe^{2+} and Fe^{3+} (Atomic No. of Fe = 26). Which one is more paramagnetic?
- MP Board-2018
14. What are transition elements? Write any four characteristic properties of transition metals.
- MP Board-2015
15. Write down the electronic configuration of
(i) Cr^{3+} (ii) Cu^+
Or
Why does a transition series contain 10 elements?
- J&K Board-2020
16. Why is Cr^{2+} reducing and Mn^{3+} oxidizing when both have d⁴ configuration?
- Assam Board-2023

Section-E : Long Answer

1. Draw the structure of dichromate ion.
Given below are the transition metal ions of 3d series:



- Select the ion which is colourless, giving the reason.
- Select the ion which is most paramagnetic, giving the reason.

OR

Draw the structure of chromate ion.

Given below are the transition metals of 4d and 5d series:



- Select the softest metal, giving the reason.
- Select the pair of metals which occur together as minerals, giving the reason.

Goa Board-2023

2. Write electronic configuration of Cu^{2+} . Calculate its magnetic moment.

Rajasthan Board-2010

B. Oxidation State of Transition Elements

Section-A : Multiple Choice Questions

1. The metal showing maximum number of oxidation states is-
- | | |
|--------|--------|
| (a) V | (b) Mn |
| (c) Fe | (d) Ni |

Rajasthan Board 2022

Ans. (b)

2. Out of the following transition elements, the maximum number of oxidation states are shown by
- | | |
|---------------------|---------------------|
| (a) Sc ($Z = 21$) | (b) Cr ($Z = 24$) |
| (c) Mn ($Z = 25$) | (d) Fe ($Z = 26$) |

CBSE-2020

Ans. (c)

3. Oxidation number central metal ion in $[\text{Zn}(\text{H}_2\text{O})_3\text{OH}]^+$ is
- | | |
|----------|--------|
| (a) +2 | (b) +1 |
| (c) zero | (d) +3 |

Chhattisgarh Board-2023

Ans. (d) :

4. The orbital configuration of Cr (atomic number 24) is $3d^54s^1$. The number of unpaired electrons in Cr^{3+} is
- | | |
|-------|-------|
| (a) 1 | (b) 2 |
| (c) 3 | (d) 4 |

NIOS Board-2018

Ans. (c)

4. (i) (a) How is the variability in oxidation states of transition metals different from that of the p-block elements?
 (b) Out of Cu^+ and Cu^{2+} , which ion is unstable in aqueous solution and why?
 (c) Orange colour of $\text{Cr}_2\text{O}_7^{2-}$ ion changes to yellow when treated with an alkali. Why?
 (ii) Chemistry of actinoids is complicated as compared to lanthanoids. Give two reasons.
- Delhi 2017
5. Give reasons for the following:
 (i) Transition metals exhibit a wide range of oxidation states.
 (ii) Cobalt (II) is very stable in aqueous solutions but gets easily oxidized in the presence of strong ligands.
 (iii) Actinoids exhibit a greater range of oxidation states than lanthanoids.
- All India 2014C
6. Compare the chemistry of the actinoids with that of lanthanoids with reference to the following:
 (i) Electronic configuration
 (ii) Oxidation states
 (iii) Chemical reactivity
- Delhi 2011C, 2010C
7. Give reasons.
 (i) Mn shows the highest oxidation state of + 7 with oxygen but with fluorine, it shows the highest oxidation state of + 4.
 (ii) Transition metals show variable oxidation states.
 (iii) Actinoids show irregularities in their electronic configurations.
- All India 2015
8. Compare the stability of +2 oxidation state for the elements of the first transition series. (Atomic number of Sc = 21 to Cu = 29)
- Delhi 2011C
9. Complete the following chemical equations:
 (i) $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \longrightarrow$
 (ii) $\text{KMnO}_4 \xrightarrow{\text{Heat}}$
 (iii) $\text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{S} + \text{H}^+ \longrightarrow$
- Delhi 2011
10. Assign suitable reasons for the following:
 (i) The Mn^{2+} compounds are more stable than Fe^{2+} towards oxidation to their +3 state.
 (ii) In the 3d series from Sc ($Z = 21$) to Zn ($Z = 30$), the enthalpy of atomization of Zn is the lowest.
 (iii) Sc^{3+} is colourless in aqueous solution whereas Ti^{3+} is coloured.
- Foreign 2014
11. Complete the following chemical equations:
 (i) $\text{Cr}_2\text{O}_7^{2-} + 6\text{Fe}^{2+} + 14\text{H}^+ \longrightarrow$
 (ii) $2\text{CrO}_4^{2-} + 2\text{H}^+ \longrightarrow$
 (iii) $2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 16\text{H}^+ \longrightarrow$
- Delhi 2013
12. Write complete chemical equations for
 (i) oxidation of Fe^{2+} by $\text{Cr}_2\text{O}_7^{2-}$ in acidic medium.
 (ii) oxidation of $\text{S}_2\text{O}_3^{2-}$ by MnO_4^- in neutral aqueous medium.
- All India 2008
13. Complete the following chemical equations:
 (i) $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{C}_2\text{O}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq}) \longrightarrow$
 (ii) $\text{MnO}_4^-(\text{aq}) + \text{Fe}^{2+}(\text{aq}) + \text{H}^+(\text{aq}) \longrightarrow$
- Foreign 2009
14. How would you account for the following?
 (i) Cr^{2+} is reducing in nature while with the same d-orbital configuration (d^4), Mn^{3+} is an oxidation agent.
 (ii) In a transition series of metals, the metal which exhibits the greatest number of oxidation states occurs in the middle of the series.
- Delhi 2009
15. Complete the following chemical reaction equations:
 (i) $\text{MnO}_4^-(\text{aq}) + \text{C}_2\text{O}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq}) \longrightarrow$
 (ii) $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{Fe}^{2+}(\text{aq}) + \text{H}^+(\text{aq}) \longrightarrow$
- Delhi 2009; All India 2009
16. Complete the following chemical reactions equations:
 (i) $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{S}(\text{g}) + \text{H}^+(\text{aq}) \longrightarrow$
 (ii) $\text{MnO}_2(\text{s}) + \text{KOH}(\text{aq}) + \text{O}_2(\text{g}) \longrightarrow$
- Delhi 2009
17. Complete the following reactions in the aqueous medium:
 (i) $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \longrightarrow$
 (ii) $\text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{S} + \text{H}^+ \longrightarrow$
- Foreign 2011
18. Complete the following chemical equations:
 (i) $\text{Fe}^{3+} + \text{I}^- \rightarrow$
 (ii) $\text{CrO}_4^{2-} + \text{H}^+ \rightarrow$
- Foreign 2011
19. Assign reasons for each of the following:
 (i) Transition metals generally form coloured compounds.
 (ii) Manganese exhibits the highest oxidation state of + 7 among the 3d-series of transition elements.
- Delhi 2011

20. Complete the following chemical equations:
- $\text{MnO}_4^-(\text{aq}) + \text{S}_2\text{O}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(l) \longrightarrow$
 - $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{Fe}^{2+}(\text{aq}) + \text{H}^+(\text{aq}) \longrightarrow$
- All India 2011, 2010
21. Complete the following equations:
- $2 \text{MnO}_4^- + 5\text{S}^{2-} + 16\text{H}^+ \rightarrow$
 - $\text{Cr}_2\text{O}_7^{2-} + 2\text{OH}^- \rightarrow$
- Foreign 2014
22. How would you account for the following?
- The highest oxidation state of a transition metal is usually exhibited in its oxide.
 - The oxidizing power of the following three oxo-ions in the series follows the order:
- $$\text{VO}_2^+ < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$$
- Delhi 2014C
23. How would you account for the following?
- Transition metals exhibit variable oxidation states.
 - Transition metals and their compound act as catalysts.
- All India 2013
24. Which metal in the first transition series (3d-series) exhibits +1 oxidation state most frequently and why?
- Delhi 2013
25. Complete the following chemical reaction equations:
- $\text{Cr}_2\text{O}_7^{2-} + \text{I}^- + \text{H}^+ \rightarrow$
 - $\text{MnO}_4^- + \text{NO}_2^- + \text{H}^+ \rightarrow$
- Delhi 2012; All India 2012
26. Account for the following:
- Mn^{2+} is more stable than Fe^{2+} towards oxidation to +3 state.
 - The enthalpy of atomization is lowest for Zn in first series (3d) of the transition elements.
- Delhi 2014
27. Describe the general trends in the following properties of the first series (3d) of the transition elements:
- Number of oxidation states exhibited.
 - Formation of oxo metal ions.
- Delhi 2014C
28. Assign reasons for the following:
- Copper (I) ion is not known to exist in aqueous solutions.
 - Both O_2 and F_2 stabilise high oxidation states of transition metals but the ability of oxygen to do so exceeds that of fluorine.
- All India 2014C
29. Why do transition elements show variable oxidation states? In 3d series (Sc to Zn), which element shows the maximum number of oxidation states and why?
- Foreign 2015
30. Suggest reasons for the following features of transition metal chemistry:
- The transition metals and their compounds are usually paramagnetic.
 - The transition metals exhibit variable oxidation states.
- Delhi 2015C
31. Complete the following chemical equation
- $8\text{MnO}_4^- + 3\text{S}_2\text{O}_3^{2-} + \text{H}_2\text{O} \rightarrow$
 - $\text{Cr}_2\text{O}_7^{2-} + 3\text{Sn}^{2+} + 14\text{H}^+ \rightarrow$
- All India 2015
32. Why do transition elements form complex compounds?
Name the elements which exhibit highest oxidation state.
- Karnataka Board-2014
33. Write the properties of Transition element with reference to (a) Oxidation state and (b) Magnetic properties.
- Jharkhand Board-2018
34. Why is Cr^{2+} reducing and Mn^{3+} oxidizing when both having d⁴ configuration?
- Assam Board-2014
35. Why transition elements show variable oxidation state?
- Haryana Board-2017
36. Calculate the number of unpaired electrons in Cr^{3+} and V^{3+} ions.
- Assam Board-2019
37. In the first transition series of elements, which element, shows highest oxidation state?
- Assam Board-2019
38. Name a transition element which does not exhibit variable oxidation state.
- Assam Board-2017
39. Which of the 3d series of transition metals exhibit the largest number of oxidation states?
- Assam Board-2017

Section-E : Long Answer

1. (i) Complete the following chemical equations:
- $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{S}(\text{g}) + \text{H}^+(\text{aq}) \longrightarrow$
 - $\text{Cu}^{2+}(\text{aq}) + \text{I}^-(\text{aq}) \longrightarrow$
- (ii) How would you account for the following?
- The oxidising power of oxoanions are in the order
- $$\text{VO}_2^+ < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$$
- The third ionization enthalpy of manganese ($Z = 25$) is exceptionally high.
 - Cr^{2+} is a stronger reducing agent than Fe^{2+} .
- All India 2010

2. (i) How does the acidified potassium permanganate solutions react with (a) iron (II) ions and (b) oxalic acid?

Write the ionic equations for the reactions.

- (ii) Name the oxo metal anion of one of the transition metals in which the metal exhibits the oxidation state equal to the group number.

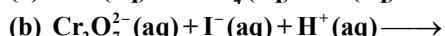
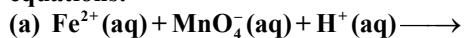
- (iii) Account for the following:

- (a) Scandium ($Z = 21$) is regarded as a transition element but zinc ($Z = 30$) is not.

- (b) $E^\circ_{(M^{2+}/M)}$ value for copper is positive.

All India 2010C

3. (i) Complete the following chemical reaction equations:



- (ii) Explain the following observations:

- (a) Transition elements are known to form many interstitial compounds.

- (b) With the same d^4 configuration, Cr^{2+} ion is reducing while Mn^{3+} ion is oxidising.

- (c) The enthalpies of atomization of the transition elements are quite high.

All India 2009

4. (i) Account for the following:

- (a) Mn shows the highest oxidation state of +7 with oxygen but with fluorine, it shows the highest oxidation state of +4.

- (b) Cr^{2+} is a strong reducing agent.

- (c) Cu^{2+} salts are coloured while Zn^{2+} salts are white.

- (ii) Complete the following equations:



All India 2015

5. The elements of 3d transition series are given as:

Sc T i V Cr Mn Fe Co Ni Cu Zn

Answer the following:

- (i) Write the element which shows maximum number of oxidation states. Give reason.

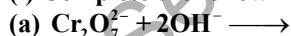
- (ii) Which element has the highest melting point?

- (iii) Which element shows only + 3 oxidation state?

- (iv) Which element is a strong oxidising agent in + 3 oxidation state and why?

Delhi 2015

6. (i) Complete the following equations:



- (ii) Account for the following:

- (a) Zn is not considered as a transition element.

- (b) Transition metals form a large number of complexes.

- (c) The E° value for the $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is much more positive than that for $\text{Cr}^{3+}/\text{Cr}^{2+}$ couple.

Delhi 2014

7. Explain:

- (a) Why do transition elements show variable oxidation state?

- (b) Give two differences between Lanthanide and Actinide.

MP Board-2012

C. General Properties of the Transition Elements

Section-A : Multiple Choice Questions

1. The shape of magnate ion is

- (a) square pyramidal (b) tetrahedral
(c) pyramidal (d) square planar

Gujarat Board 2023 (March)

Ans. (b)

2. Which of the following Cu^{2+} halide is not known?

- (a) CuBr_2 (b) CuI_2
(c) CuCl_2 (d) CuF_2

Gujarat Board 2023 (July)

Ans. (b)

3. Which of the following is a Heptoleptic complex?

- (a) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (b) $\text{Na}_3[\text{Co}(\text{NH}_3)_6]$
(c) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Br}_2$ (d) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$

Manipur Board 2023

Ans. (c)

4. Assertion (A) : Transition metals have high melting point.

Reason (R) : Transition metals have completely filled d-orbitals.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

- (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).

- (c) Assertion (A) is correct, but Reason (R) is incorrect statement.

- (d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

Ans. (a)

5. Assertion (A) : Transition metals have low melting points.

Reason (R) : The involvement of greater number of $(n - 1)d$ and ns electrons in the interatomic metallic bonding.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A)..

- (b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).

- (c) Assertion (A) is correct, but Reason (R) is wrong statement.

- (d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

Ans. (d)

23. Increasing order of paramagnetism is:

- (a) Cu^{2+} , Co^{2+} , Mn^{2+} , Ni^{2+}
- (b) Co^{2+} , Cu^{2+} , Mn^{2+} , Ni^{2+}
- (c) Cu^{2+} , Ni^{2+} , Co^{2+} , Mn^{2+}
- (d) Mn^{2+} , Co^{2+} , Ni^{2+} , Cu^{2+}

Haryana Board-2016

Ans. (c)

24. Oxidation in alkaline medium using KMnO_4 , the oxidation number of manganese changes from

- (a) +7 to +2
- (b) +2 to +7
- (c) +7 to +4
- (d) +7 to +5

Manipur Board-2019

Ans. (c)

25. Which one is colored?

- (a) Cu_2Cl_2
- (b) $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$
- (c) $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$
- (d) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$

Haryana Board-2018

Ans. (c)

26. Which of the following is diamagnetic?

- (a) Zn^{2+}
- (b) Cu^{2+}
- (c) Cr^{2+}
- (d) Cr^{3+}

Rajasthan Board-2011

Ans. (a)

27. Formation of coloured ions is possible when compound contains:

- (a) Paired electrons
- (b) unpaired electrons
- (c) lone pair of electrons
- (d) (a) and (c)

Tamilnadu Board, Sep.-2016

Ans. (b)

28. Pick out the colourless ion of transition metal from the following:

- (a) Zn^{2+}
- (b) Cu^{2+}
- (c) Fe^{2+}
- (d) Mn^{2+}

Tamilnadu Board, March-2016

Ans. (a)

29. Which of the following is a transition element?

- (a) Cd
- (b) Ag
- (c) In
- (d) Hg

Gujarat Board-2016

Ans. (a)

30. Which of the following ion has the maximum theoretical magnetic moment?

- (a) Cr^{3+}
- (b) Ti^{3+}
- (c) V^{3+}
- (d) Co^{3+}

Gujarat Board-2018

Ans. (d) :

31. Which of the following ion is paramagnetic?

- (a) Zn^{2+}
- (b) O_2^{2-}
- (c) Cu^+
- (d) Cr^{3+}

Gujarat Board-2018

Ans. (d) :

32. Which ion has magnetic moment 5.90 BM?

- (a) Fe^{2+}
- (b) Fe^{3+}
- (c) CO^{2+}
- (d) Mn^{4+}

Gujarat Board-2017

Ans.(b)

33. Which of the following ion will not form coloured aqueous solution?

- (a) Ni^{2+}
- (b) Fe^{3+}
- (c) Ti^{4+}
- (d) Cu^{2+}

Gujarat Board-2017

Ans.(c)

34. Which ion has highest theoretical magnetic moment?

- (a) Co^{3+}
- (b) Cr^{3+}
- (c) Ti^{3+}
- (d) Fe^{3+}

Gujarat Board-2018

Ans. (d)

35. Which is the magnetic momentum of cuprous chloride on the basis of axial rotation?

- (a) 1.73 B.M.
- (b) 0.0 B.M.
- (c) 4.90 B.M.
- (d) 2.83 B.M.

Gujarat Board-2019

Ans. (b)

36. Sentence (A) and its reason (R) is given below, For it which option is correct from given options?

Sentence (A): Atomic radii from Cr to Cu is almost similar

Reason (R): Shielding effect of entering electron in 3d orbital decreases repulsion force of 4s orbital electrons towards nucleus.

- (a) A and R both are true R is correct explanation of A.
- (b) A and R both are true R is not correct explanation of A.
- (c) A is correct, R is wrong.
- (d) A is wrong, R is correct.

Gujarat Board-2019

Ans. (c)

37. Fe, Co, Ni are magnetic substance of which type?

- (a) Paramagnetic
- (b) Ferromagnetic
- (c) Diamagnetic
- (d) Anti-ferromagnetic

MP Board-2018, 2012

Ans. (b)

Section-B : Very Short Answer

- | | |
|--|---|
| 1. What is the effect of increasing pH on solution of $K_2Cr_2O_7$?
Gujarat Board 2023 (July) | 15. (a) Account for the following:
(i) Transition metals show variable oxidation states.
(ii) Trivalent lanthanoid ions are coloured both in solid state and aqueous solutions.
CBSE-2021 |
| 2. Write reaction to prepare $KMnO_4$ and its two properties.
Gujarat Board 2022 (July) | 16. Why does Mn show maximum number of oxidation states? Which oxidation state of Mn is most stable and why?
CBSE-2021 |
| 3. (v) Draw the structure of MnO_4^- Ion.
Haryana Board 2023 | 17. Define transition elements. Why do transition metals have higher enthalpies of atomisation? Which element in 3d series has lowest enthalpy of atomisation and why?
CBSE-2022 |
| 4. Transition metal acts as good catalyst.
Haryana Board 2023 | 18. Define transition metals. Why Zn, Cd and Hg are not called transition metals? How is the variability in oxidation states of transition metals different from that of p-block elements?
CBSE-2022 |
| 5. Why transition metals and many of their compounds show paramagnetic behaviour?
Haryana Board 2023 | 19. Account for the following:
(i) Cu^{2+} salts are coloured while Zn^{2+} salts are white.
(ii) E° value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} .
CBSE-2022 |
| 6. Write oxidation reactions of potassium permanganate. (any four)
MP Board 2020 | 20. (b) Define transition elements. Which of the d-block elements may not be regarded as the transition elements? Why transition metals generally form coloured compounds?
CBSE-2022 |
| 7. Write the preparation of $K_2Cr_2O_7$ from chromite ore.
Kerala Board 2023 | 21. Write balanced chemical equations for the following processes:
(a) Cl_2 is passed through slaked lime.
(b) SO_2 gas is passed through an aqueous solution of Fe(III) salt.
CBSE-2019 |
| 8. Give an example for a bidentate ligand.
Kerala Board 2023 | 22. (a) Write chemical equations involved in the preparation of $KMnO_4$ from MnO_2
(b) Actinoids show wide range of oxidation states. Why?
CBSE-2019 |
| 9. (a) How is chlorine prepared in laboratory using $KMnO_4$?
(b) Why chlorine water on standing loses yellow colour?
Karnataka board 2023 | 23. Give reasons:
(a) MnO is basic whereas Mn_2O_7 is acidic in nature
(b) Transition metals form alloys
CBSE-2019 |
| 10. Explain the following with reason-
(a) Lanthanoid Contraction
(b) d-block elements form coloured ions
Uttarakhand Board 2023 | 24. Write the hybridization and magnetic character of following complexes:
(i) $[Fe(H_2O)_6]^{2+}$
(ii) $[Fe(CO)_5]$
(Atomic no. of Fe = 26)
CBSE-2019 |
| 11. What are the characteristics of the transition metals?
(b) In d-block Elements-
(a) Which of the elements may not be regarded as the transition elements?
(b) Why transition metals and many of their compounds are paramagnetic?
Uttarakhand Board 2022 | 25. (a) Of the d ⁴ species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidising.
(b) The d ¹ configuration is very unstable in ions
CBSE-2019 |
| 12. Why do the transition elements exhibit higher enthalpies of atomisation?
Uttarakhand Board 2022 | 26. Write the preparation of sodium dichromate from chromite ore.
CBSE-2019 |
| 13. Write the balanced ionic equations showing the oxidising action of acidified dichromate ($Cr_2O_7^{2-}$) solution with (i) Iron (II) Ion and (ii) tin (II) ion.
CBSE-2020 | |
| 14. Complete and balance the following chemical equations:
(a) $MnO_4^- + H_2O + I^- \rightarrow$
(b) $MnO_4^- + H^+ + I^- \rightarrow$
CBSE-2020 | |

27. What happens when AgCl is doped with CdCl_2 ? What is the name of this defect?
CBSE-2019
28. Give balanced equation for the following reaction:
Potassium dichromate is treated with acidified ferrous sulphate solution.
ISC Board-2016
29. Potassium iodide treated with acidified potassium permanganate solution.
ISC Board-2013
30. Give the balanced equation for acidified potassium permanganate and oxalic acid.
ISC Board-2012
31. How does potassium dichromate prepared from a sample of chromite ore? Give the balanced equations for the chemical reactions involved.
ISC Board-2014
32. Give balanced equation for the following reaction:
Potassium permanganate is heated with concentrated hydrochloric acid.
ISC Board-2017
33. Iron is ferromagnetic in nature. Explain why?
ISC Board-2011
34. In a given transition series, there is no significant changes in the atomic radii of elements with increase in atomic number. Explain why?
ISC Board-2011
35. Explain why transition metals form complex compounds?
ISC Board-2012
36. Explain the following:
 (a) Why do transition metal ions possess a great tendency to form complexes?
 (b) The paramagnetic character in 3d-transition series elements increases upto Mn and then decreases.
ISC Board-2015
37. What is the electronic configuration chromium atom ($Z = 24$)? Give a reason for your answer.
ISC Board-2012
38. Give reason Zn^{2+} salts are white but Cu^{2+} salts blue in colour.
ISC Board-2010, 2013, 2014
39. Write the balanced equation for silver chloride when treated with potassium cyanide solution. What type of compound is formed?
ISC Board-2000, 2001, 2003
40. Write the balanced equation for the following: Copper with dilute nitric acid.
ISC Board-2004
41. Give the balanced chemical equation for zinc is added to sodium argentocyanide solution.
ISC Board-2011
42. Write the balanced equation for silver sulphide and sodium cyanide.
ISC Board-2008
43. Account for the following:
The second and third series members in each group of the transition elements have very similar atomic radii.
Delhi 2008C
44. There is a close similarity in physical and chemical properties of the 4d and 5d-series of the transition elements, much more than expected on the basis of usual family relationship.
Foreign 2010
45. Unlike Cr^{3+} , Mn^{2+} , Fe^{3+} and the subsequent other V^{2+} ions of 3d series of elements, the 4d and 5d series do not form cationic species. Give reason.
All India 2011, 2010
46. State reasons for the following:
Unlike Cr^{3+} , Mn^{2+} , Fe^{3+} and the subsequent other M^{2+} ions of the 3d-series of elements, the 4d and the 5d-series metals generally do not form stable cationic species.
All India 2011, 2010
47. How would you account for the following? The $E_{\text{M}^{2+}/\text{M}}^{\circ}$ for copper is positive (0.34 V). Copper is the only metal in the first series of transition elements showing this behaviour.
HOTS; All India 2012
48. Assign reason for the following: Copper (I) ion is not known in aqueous solution.
All India 2011, 2010; Delhi 2011
49. Transition metals and their compounds generally exhibit a paramagnetic behaviour. Give reason.
All India 2011
50. Cr^{2+} is a strong reducing agent whereas Mn^{3+} with the same (d^4) configurations is an oxidizing agent. Give reason.
Delhi 2011C
51. Explain the following observation: The enthalpies of atomization of transition metals are quite high.
Foreign 2010
52. Sc(21), is a transition element but Ca (20) is not. Why?
All India 2012C
53. Transition metals are much harder than the alkali metals. Why?
All India 2014C
54. Zn^{2+} salts are white while Cu^{2+} salts are coloured. Why?
All India 2015
55. Write chemical equation, when PtF_6 and xenon are mixed together.
Delhi 2008
56. Iron dissolves in HCl to form FeCl_2 but not FeCl_3 .
HOTS; Foreign 2009; All India 2008C
57. Complete the following chemical equation:
 $\text{Fe}^{3+} + \text{SO}_2 + \text{H}_2\text{O} \rightarrow$
Foreign 2011, Delhi 2011C

58. Complete the following chemical equation:
 $\text{Cu}^{2+}(\text{aq}) + \text{NH}_3(\text{aq}) \rightarrow$ Delhi 2008
59. Complete the following equation:
 $\text{Cu} + \text{HNO}_3(\text{dilute}) \rightarrow$ All India 2012; Foreign 2009
60. Most of the transition metals and their compounds have catalytic activity, why? Tamil Nadu Board-2015
61. Complete and balance the following chemical equations :
(a) $\text{Fe}^{2+} + \text{MnO}_4^- + \text{H}^+ \longrightarrow$
(b) $\text{MnO}_4^- + \text{H}_2\text{O} + \text{I}^- \longrightarrow$ UP Board-2018
62. Transition elements have high melting points. Why? Manipur Board-2018
63. An oxide of Chromium is found to have the following % composition: 68.4% Cr and 31.6% Oxygen. Determine the empirical formula of the compound.
(Atomic mass of Cr = 52 g mol⁻¹ and O = 16 g mol⁻¹) NIOS Board-2019
64. Zr and Hf have almost identical atomic radii give reason. Karnataka Board-2016
65. Why Cu (I) is colourless and Cu (II) is blue in colour ? Punjab Board-2019
66. Why transition metals act as good catalysts? Punjab Board-2021
67. Why are Mn²⁺ compounds more stable than Fe²⁺ towards oxidation to their +3 state? Punjab Board-2021
68. The general electronic configuration of inner transition elements is Haryana Board-2021
69. a) Zr and Hf have almost identical radii: Give reason.
b) Name the gas liberated when Lanthanoids (Ln) react with acids. Karnataka Board-2019
70. Zinc and Mercury are low boiling liquids. Name the technique used to refine these metals. Kerala Board-2021
71. The transition metals form a large number of complex compounds. Give main reasons. Haryana Board-2016
72. Discuss briefly the following properties of transition metals:
(a) Ionic radii
(b) Complexing tendency
(c) Catalytic properties Haryana Board-2017
73. Why does scandium show preferably (+3) oxidation state ? Manipur Board-2022
74. Why Zn^{2+} is diamagnetic whereas Cr^{3+} is paramagnetic ? Andhra Pradesh Board-2018
75. Calculate the magnetic moment of divalent ion in aqueous solution if its atomic number is 25. Andhra Pradesh Board-2016
76. Represent the structure of dichromate ion. Kerala Board-2016
77. Transition element form interstitial compound. Give one reason. Rajasthan Board-2017
78. How would you account for irregular variation of 1st and 2nd ionisation enthalpies in the 1st series of transition elements? Assam Board-2018
79. What are interstitial compounds? Assam Board-2018
80. Cu^+ ion is not stable in aqueous solution. Explain. Assam Board-2018
81. (a) Transition metal compounds are generally coloured. Why?
(b) What are interstitial compounds? Assam Board-2016
82. General electronic configuration of inner transition element is MP Board-2012
83. Why are zinc, cadmium and mercury normally not considered as transition elements? Nagaland Board-2017
84. Why do transition elements acts as good catalyst ? Nagaland Board-2017

Section-C : Short Answer

1. Given reason:
(i) Transition elements exhibit higher enthalpies of atomisation
(ii) In aqueous solution, Cr^{2+} is stronger reducing agent than Fe^{2+}
(iii) The second ionisation enthalpy of Cu is higher than Zn Gujarat Board 2023 (March)
2. What is aqua regia? Write down balanced chemical equations of it's reaction with Au and Pt. Gujarat Board 2023 (March)
3. Following ions are given :
 $\text{Cr}^{2+}, \text{Cu}^{2+}, \text{Cu}^+, \text{Fe}^{2+}, \text{Fe}^{3+}, \text{Mn}^{3+}$
Identify the ion which is
(i) a strong reducing agent.
(ii) unstable in aqueous solution.
(iii) a strong oxidising agent.
Give suitable reason in each. CBSE-2020
4. (a) Account for the following:
(i) Copper (I) compounds are white whereas Copper (II) compounds are coloured.

- (ii) Chromates change their colour when kept in an acidic solution.
 (iii) Zn, Cd, Hg are considered as d-block elements but not as transition elements.
- (b) Calculate the spin-only moment of Co^{2+} ($Z = 27$) by writing the electronic configuration of Co and Co^{2+}
- CBSE-2020
5. (i) Why is $E^\circ_{\text{Cu}^{2+}/\text{Cu}}$ exceptionally positive ?
 (ii) Why is Sc^{3+} colourless but Ti^{3+} is coloured?
 (iii) Why do transition metals and their compounds show catalytic activities?
- CBSE-2021
6. (a) Why is $E^\circ(\text{Cu}^{2+} \mid \text{Cu})$ exceptionally positive? Although Cu^+ ion has $3d^{10}$ configuration, yet it is unstable in an aqueous solution. Why? What is the reason for the stability of Cu^{2+} over Cu^+ ion?
- CBSE-2021
7. (b) Give reasons for the following:
 (i) Transition metals form alloys.
 (ii) Zinc has lowest enthalpy of atomization.
 (iii) Manganese shows higher oxidation state of +4 with Fluorine but shows +7 with Oxygen.
- CBSE-2021
8. Account for the following:
 (a) Transition metals form large number of complex compounds.
 (b) Cr^{2+} is a strong reducing agent.
- CBSE-2021
9. Why do transition elements show variable oxidation states? How are transition metals different from p-block elements in terms of variability of oxidation states?
- CBSE-2021
10. Account for the following:
 (i) Transition metals and their compounds show catalytic activities.
 (ii) Cu^{2+} is coloured while Cu^+ is colourless in aqueous solution.
 (iii) E° value for Mn^{2+}/Mn couple is highly negative.
- CBSE-2022
11. (i) Which metal in the first series of transition metals exhibits +1 oxidation state most frequently and why ?
 (ii) Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidising, why?
 (iii) Name a transition element in 3d series
 (I) Which does not exhibit variable oxidation states, and
 (II) Which shows a larger number of oxidation states.
- CBSE-2022
12. Account for the following :
 (i) Transition metals generally form coloured compounds.
 (ii) Zn has the lowest enthalpy of atomisation.
 (iii) Atomic radii of 5d and 4d series of elements are almost identical.
- CBSE-2022
13. The elements of 3d transition series are given below :
 Sc, Ti V Cr Mn Fe Co Ni Cu Zn
 Answer the following questions:
 (a) Which element is a strong reducing agent +2 oxidation state and why ?
 (b) Which element has the highest melting point and why ?
 (c) Which element of the first transition series has the highest third ionisation enthalpy ?
- CBSE-2022
14. Define transition elements. Write two characteristics of transition elements.
- CBSE-2022
15. (a) (i) Silver atom has completely filled d-orbitals in its ground state, it is still considered to be a transition element. Justify the statement.
 (ii) Why are $E^\circ_{\text{M}^{2+}/\text{M}}$ values of Mn and Zn more negative than expected ?
 (iii) Why do transition metals form alloys ?
- CBSE-2022
16. (b) Answer the following questions on the basis of the figure given below :
-
- CBSE-2022
- (i) Which element in 3d series has lowest enthalpy of atomization ?
 (ii) why do metals of the second and third series have greater enthalpies of atomization ?
 (iii) Why are enthalpies of atomization of transition metals quite high ?
- CBSE-2022
17. (i) Which ion amongst the following is colourless and why ?
 $\text{Ti}^{4+}, \text{Cr}^{3+}, \text{V}^{3+}$
 (Atomic number of Ti = 22, Cr = 24, V = 23)
 (ii) Why is Mn^{2+} much more resistant than Fe^{2+} towards oxidation ?
 (iii) Highest oxidation state of a metal is shown in its oxide or fluoride only. Justify the statement.
- CBSE-2022
18. (i) Why are melting points of transition metals high ?
 (ii) Why the transition metals generally form coloured compounds ?
 (iii) Why E° value for $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is highly positive ?
- CBSE-2022

19. Account for the following :
 (i) Cr^{2+} is a strong reducing agent.
 (ii) Ti^{3+} is coloured whereas Sc^{3+} is colourless in aqueous solution.
 (iii) Zn, Cd and Hg are not called transition elements.
- CBSE-2022
20. Account for the following :
 (i) Transition metals and their compounds show catalytic activities.
 (ii) Zn, Cd and Hg are non-transition elements.
 (iii) Zr and Hf are of almost identical atomic radii.
- CBSE-2022
- 21.
- | $E^\ominus_{\text{M}^{2+}/\text{M}}$ | Cr | Mn | Fe | Co | Ni | Cu | Zn |
|--------------------------------------|-------|-------|-------|-------|-------|-------|----|
| -0.91 | -1.18 | -0.44 | -0.28 | -0.25 | +0.34 | -0.76 | |
- From the given E^\ominus values of the first row transition elements, answer the following questions :
 (i) Why is $E^\ominus_{\text{Mn}^{2+}/\text{Mn}}$ value highly negative as compared to other elements ?
 (ii) What is the reason for the irregularity in the above E^\ominus values ?
 (iii) Why is $E^\ominus_{\text{Cu}^{2+}/\text{Cu}}$ value exceptionally positive ?
- CBSE-2022
22. (a) Account for the following :
 (i) Zr and Hf have almost similar atomic radii.
 (ii) Transition metals show variable oxidation states.
 (iii) Zinc has lowest enthalpy of atomization.
- CBSE-2022
23. (b) Why transition metals and their compounds act as good catalyst ? How is the variability in oxidation states of transition metals different from that of the non-transition metals ? Illustrate with examples.
- CBSE-2022
24. Following ions of 3d transition series are given :
 $\text{Ti}^{2+}, \text{Fe}^{2+}, \text{Cu}^{2+}, \text{Zn}^{2+}$
 (Atomic number : Ti = 22, Fe = 26, Cu = 29, Zn = 30)
 (Identify the ion, which is
 (i) a strong reducing agent in aqueous solution.
 (ii) More stable than its + 1 oxidation state.
 (iii) Colourless in aqueous solution.
 Give a suitable reason in each.)
- CBSE-2022
25. Following ions of 3d-transition series are given :
 $\text{Ti}^{4+}, \text{V}^{3+}, \text{Cr}^{3+}, \text{Mn}^{3+}$
 (Atomic number : Ti = 22, V = 23, Cr = 24, Mn = 25)
 Identify the ion which is
 (i) Most stable in aqueous solution.
 (ii) A strong oxidizing agent.
- (iii) Colourless in aqueous solution.
 Give suitable reason in each.)
- CBSE-2022
26. Account for the following :
 (a) Transition elements show variable oxidation states.
 (b) $E^\ominus_{\text{Cu}^{2+}/\text{Cu}}$ value for copper is highly positive.
 (c) Cr^{2+} is a strong reducing agent.
- CBSE-2022
27. Give reasons for the following statements :
 (a) Transition elements and their compounds act as good catalysts.
 (b) $E^\ominus_{(\text{Mn}^{2+}/\text{Mn})}$ value is highly negative as compared to other elements.
 (c) Cr^{2+} is a strong reducing agent.
- CBSE-2022
28. Give reasons for the following statements :
 (a) Copper does not displace hydrogen from acids.
 (b) Transition metals and most of their compounds show paramagnetic behaviour.
 (c) Zn, Cd and Hg are soft metals.
- CBSE-2022
29. Give reasons for the following :
 (a) Transition metals form complex compounds.
 (b) E^\ominus values for $(\text{Zn}^{2+}/\text{Zn})$ and $(\text{Mn}^{2+}/\text{Mn})$ are more negative than expected.
 (c) Actinoids show wide range of oxidation states.
- CBSE-2019
30. Give reasons for the following :
 (i) Transition metals form alloys.
 (ii) Mn_2O_3 is basic whereas Mn_2O_7 is acidic.
 (iii) Eu^{2+} is a strong reducing agent.
- CBSE-2019
31. Give reasons for the following:
 (a) Transition metals have high enthalpies of atomization.
 (b) Manganese has lower melting point even though it has a higher number of unpaired electrons for bonding.
 (c) Ce^{4+} is a strong oxidising agent.
- CBSE-2019
32. When FeCr_2O_4 is fused with Na_2CO_3 in the presence of air it gives a yellow solution of compound (A). Compound (A) on acidification gives compound (B). Compound (B) on reaction with KCl forms an orange coloured compound (C). An acidified solution of compound (C) oxidizes Na_2SO_3 to (D). Identify (A), (B), (C) and (D).
- CBSE-2019
33. How will you convert the following :
 (i) Impure Nickel to pure Nickel
 (ii) Zinc blende to Zinc metal
 (iii) $[\text{Ag}(\text{CN})_2]^-$ to Ag
- CBSE-2019

34. When MnO_2 is fused with KOH in the presence of KNO_3 as an oxidizing agent, it gives a dark green compound (A). Compound (A) disproportionates in acidic solution to give purple compound (B). An alkaline solution of compound (B) oxidises KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D). Identify (A), (B), (C), and (D).
- CBSE-2019
35. (a) The elements of 3d transition series are given as :
 Sc Ti V Cr Mn Fe Co Ni Cu Zn
 Answer the following questions :
 (i) Which element is a strong reducing agent in +2 oxidation state and why ?
 (ii) Which element shows maximum number of oxidation states and why ?
 (iii) Which element shows only +3 oxidation state ?
 (b) Write balanced ionic equations for the following reactions in aqueous solution :
 (i) $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \longrightarrow$
 (ii) $\text{MnO}_4^- + \text{Fe}^{2+} + \text{H}^+ \longrightarrow$
- CBSE-2019
36. (a) Complete the following chemical reactions :
 (i) $\text{Na}_2\text{Cr}_2\text{O}_7 + \text{KCl} \rightarrow$
 (ii) $2 \text{MnO}_4^- + 5\text{SO}_3^{2-} + 6$
 (b) How does the colour $\text{Cr}_2\text{O}_7^{2-}$ of change when treated with an alkali ?
- CBSE-2019
37. Explain the method of preparation of sodium dichromate from chromite ore. Give the equation representing oxidation of ferrous salts by dichromate ion.
- CBSE-2019
38. Complete the following reactions :
 (a) $\text{MnO}_2 + \text{KOH} + \text{O}_2 \rightarrow$
 (b) $\text{I}^- + \text{MnO}_4^- + \text{H}^+ \rightarrow$
 (c) $\text{Cr}_2\text{O}_7^{2-} + \text{Sn}^{2+} + \text{H}^+ \rightarrow$
- CBSE-2019
39. What happens when
 (a) Silver is leached with NaCN in the presence of air ?
 (b) Copper matte is charged into silica lined converter and hot air blast is blown ?
 (c) NaCN is added in an ore containing PbS and ZnS during concentration by froth floatation method ?
- CBSE-2019
40. (i) Account for the following:
 (a) The transition metals and their compounds act as good catalysts.
 (b) The lowest oxide of transition metal is basic, whereas the highest is amphoteric/acidic.
 (c) A transition metal exhibits higher oxidation states in oxides and fluorides.
- (ii) Describe the reactions involved in the preparation of $\text{K}_2\text{Cr}_2\text{O}_7$ from chromite ore.
- All India 2011
41. What is meant by disproportionation? Give two examples of disproportionation reactions in aqueous solution.
- All India 2011C
42. Describe the preparation of potassium permanganate from pyrolusite ore. Write the ionic equation for the reaction that takes place between acidified KMnO_4 solution and iron (II) ions.
- Delhi 2010C
43. Account for the following:
 (i) The enthalpies of atomization of the transition metals are high.
 (ii) The lowest oxide of a transition metal is basic, the highest is amphoteric or acidic.
 (iii) Cobalt (II) is stable in aqueous solution but in the presence of complexing agents, it is easily oxidized.
- All India 2010C
44. Explain the following observations:
 (i) Cu^+ ion is unstable in aqueous solution.
 (ii) Although Co^{2+} ion appears to be stable, it is easily oxidized to Co^{3+} ion in the presence of a strong ligand.
 (iii) The $E^\circ_{\text{Mn}^{2+}/\text{Mn}}$ value for the manganese is much more than expected from the trend for other elements in the series.
- Delhi 2009
45. Explain the following observations:
 (i) With the same d-orbital configuration (d^4), Cr^{2+} ion is a reducing agent while Mn^{3+} ion is an oxidising agent.
 (ii) Cu^+ ion is not stable in aqueous solution.
 (iii) Among the 3d-series of transition elements, the largest number of oxidation states are exhibited by manganese.
- Foreign 2009
46. Give reason for the following observations:
 (i) Of the d^4 species, Cr^{2+} is strongly reducing whereas manganese (III) is strongly oxidising.
 (ii) The enthalpies of atomization of the transition metals are quite high.
 (iii) Interstitial compounds are well known for transition metals.
- All India 2009
47. Describe the preparation of potassium dichromate from chromite ore with chemical equations involved. What is the effect of increasing pH on a solution of potassium dichromate.
- All India 2009
48. (i) Describe the commercial preparation of potassium permanganate from pyrolusite ore.
 (ii) Write ionic equation to represent the reaction of acidified KMnO_4 solution with oxalic acid.
- Delhi 2008C

49. (i) Describe how potassium dichromate is prepared from sodium chromate?
(ii) The colour of potassium dichromate solution changes with the change in pH of the solution. Explain how?
- All India 2008C
50. How would you account for the following?
(i) Metal-metal bonding is more extensive in the 4d and 5d-series of transition elements than 3d-series.
(ii) Mn (III) undergoes disproportionation reaction easily.
(iii) Co (II) is easily oxidized in the presence of strong ligands.
- Foreign 2011
51. Explain the following observations:
(i) The enthalpies of atomization of transition elements are quite high.
(ii) There occurs much more frequent metal-metal bonding in compounds of heavy transition metals (i.e. 4d and 5d series).
(iii) Mn^{2+} is much more resistant than Fe^{2+} towards oxidation.
- Delhi 2012
52. On what ground can you say that scandium ($Z = 21$) is a transition element but zinc ($Z = 30$) is not?
- All India 2008
53. (i) Account for the following:
(a) Cu^+ is unstable in an aqueous solution.
(b) Transition metals form complex compounds.
(ii) Complete the following equation:
 $Cr_2O_7^{2-} + 8H^+ + 3NO_2 \longrightarrow$
- All India 2015
54. (i) How would you account for the following?
(a) Highest fluoride of Mn is MnF_4 whereas the highest oxide is Mn_2O_7 .
(b) Transition metals and their compounds show catalytic properties.
(ii) Complete the following equation:
 $3MnO_4^{2-} + 4H^+ \longrightarrow$
- Foreign 2015
55. From the given data of E° values, answer the following questions:
- | E° | Cr | Mn | Fe | Co | Ni | Cu |
|------------------------|-------|-------|-------|-------|-------|-------|
| $E^\circ_{(M^{2+}/M)}$ | -0.91 | -1.18 | -0.44 | -0.28 | -0.25 | +0.34 |
- (i) Why is $E^\circ_{Cu^{2+}/Cu}$ value exceptionally positive?
(ii) Why is $E^\circ_{(Mn^{2+}/Mn)}$ value highly negative as compared to other elements?
(iii) Which is a stronger reducing agent Cr^{2+} or Fe^{2+} ? Give reason.
- All India 2015
56. Explain the following observations:
(i) The transition elements have great tendency for complex formation.
- (ii) There is a gradual decrease in the atomic sizes of transition elements in a series with increasing atomic numbers.
- Delhi 2008C
57. State reasons for the following observations:
(i) The enthalpies of atomization of transition elements are quite high.
(ii) There is a greater horizontal similarity in the properties of the transition elements to that of the main group elements.
- Foreign 2009
58. Explain the following observations about the transition elements:
(i) There is in general, an increase in density of elements from titanium ($Z = 22$) to copper ($Z = 29$).
(ii) There occurs much more frequent metal-metal bonding in compounds of heavy transition elements (4d and 5d series).
- Delhi 2009
59. Write balance chemical equations of two reactions in which $KMnO_4$ acts as an oxidizing agent in the acidic medium.
- Delhi 2011C
60. Explain the following observations:
(i) Generally, there is an increase in density of elements from titanium ($Z = 22$) to copper ($Z = 29$) in the first series of transition elements.
(ii) Transition elements and their compounds are generally found to be good catalysts in chemical reactions.
- Delhi 2010
61. Explain the following observations:
(i) Transition elements generally form coloured compounds.
(ii) Zinc is not regarded as a transition element.
- Delhi 2010
62. Explain the following observations:
(i) Among the divalent cations in the first series of transition elements, manganese exhibits the maximum paramagnetism.
(ii) Cu^+ ion is not known in aqueous solutions.
- All India 2010
63. Account for the following:
(i) Cu^+ ions are not stable in aqueous solution.
(ii) Most of the transition metal ions exhibit paramagnetic behaviour.
- Delhi 2010C
64. Account for the following:
(i) In the series Sc to Zn, the enthalpy of atomization of zinc is the lowest.
(ii) E° value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} .
- Delhi 2010C
65. Explain the following observations:
(i) Many of the transition elements are known to form interstitial compounds.
(ii) There is a general increase in density from titanium ($Z = 22$) to copper ($Z = 29$).
- All India 2012

66. Explain each of the following observations:
 (i) With the same d-orbital configuration (d^4), Cr^{2+} is a reducing agent while Mn^{3+} is an oxidizing agent.
 (ii) There is hardly any increase in atomic size with increasing atomic numbers in a series of transition metals.
- All India 2012
67. Assign a reason for each of the following observations:
 (i) The transition metals (with the exception of Zn, Cd and Hg) are hard and have high melting and boiling points.
 (ii) The ionization enthalpies (first and second) in the first series of the transition elements are found to vary irregularly.
- Delhi 2014C
68. Assign reason for each of the following:
 (i) Transition elements exhibit paramagnetic behaviour.
 (ii) Co^{2+} is easily oxidized in the presence of a strong ligands.
- Delhi 2014C
69. Describe the preparation of potassium permanganate. How does the acidified permanganate solution react with oxalic acid? Write the ionic equations for the reactions.
- All India 2015C
70. Describe the oxidizing action of potassium dichromate and write the ionic equations for its reactions with (i) iodide and (ii) H_2S .
- All India 2015C
71. What are transition elements? Write two characteristics of the transition elements.
- Delhi 2015
72. What is meant by 'disproportionation'? Give an example of a disproportionation reaction in aqueous solution.
- Delhi 2015C
73. When chromite ore, FeCr_2O_4 , is fused with NaOH in the presence of air, a yellow-coloured compound (A) is obtained, which on acidification with dilute sulphuric acid gives a compound (B). Compound (B) on reaction with KCl forms an orange coloured crystalline compound (C).
 (i) Write the formulae of the compounds (A), (B) and (C).
 (ii) Write one use of compound (C).
- Delhi 2016
74. Ti^{4+} compounds are colourless in aqueous solution but Ti^{3+} compounds are violet coloured. Explain.
- Assam Board-2022
75. What is meant by 'disproportionation' of an oxidation state? Give an example.
- Assam Board-2022
76. Which of the elements of d-block are not transition element? Write with reason.
- Uttarakhand Board-2020
77. Calculate the magnetic moment of a trivalent ion in aqueous solution if its atomic number is 26.
- Gujarat Board-2021
78. Write balanced chemical equations for the reactions of potassium permanganate with :
 (i) Fe^{2+} ions in acidic medium (ionic equation),
 (ii) H_2S in neutral medium and
 (iii) KI in alkaline medium
 Write its two important uses.
- NIOS Board-2022
79. a) Transition elements show catalytic property. Give two reasons.
 b) Name one 3d series element that do not show variable oxidation state.
- Karnataka Board-2020
80. i) What are interstitial compounds?
 ii) Transition metals show good catalytic property. Give any two reasons.
- Karnataka Board-2019
81. Write the balanced chemical equation involve in the manufacture of potassium - dichromate from chromite ore.
- Karnataka Board-2019
82. How is potassium permanganate (KMnO_4) prepared from MnO_2 ? Write the equations.
- Karnataka Board-2018
83. a) Why 3d-series of elements acts as good catalyst?
 b) Given reason : Ti^{4+} salts are colourless where as Cr^{3+} salts are coloured.
- Karnataka Board-2018
84. i) a) Calculate the spin only magnetic moment of Fe^{2+} .
 [Atomic number of iron = 26]
 b) Which element of 3d series exhibits maximum oxidation state?
- Karnataka Board-2017
85. How is KMnO_4 [Potassium permanganate] is prepared from MnO_2 ? Write equations.
- Karnataka Board-2017
86. a) Calculate the spin only magnetic moment of Fe^{2+} .
 b) Why Sc^{3+} salt are colourless where as Cr^{3+} salts are coloured.
- Karnataka Board-2016
87. Give reason (one each) for the following.
 a) Transition metals are good catalytic agents.
 b) Second ionisation Enthalpy of copper is very high.
 c) The spin only magnetic moment of Sc^{3+} is zero.
 (Z = 21). 3
- Karnataka Board-2015
88. Write equations in the preparation of potassium dichromate from chromite ore (FeCr_2O_4). 3
- Karnataka Board-2015

89. With reference to the first row transition series:
 i) Name the metal which possesses maximum number of oxidation states,
 ii) Among Zn^{+2} and Cu^{+2} which is colourless?
 iii) Between Ti^{2+} and V^{2+} which ion contains more number of unpaired electrons? 3
Karnataka Board-2014
90. Write down the balanced chemical equations for the following:
 (a) Stannous chloride (acidified) reacts with O_3 .
 (b) Copper reacts with concentrated H_2SO_4 .
NIOS Board-2016
91. (i) Which of the following are coloured in aqueous solution ? Give reasons : V^{3+} , Cu^{+} , Sc^{3+} , Fe^{3+}
 (ii) Which of the following oxides are amphoteric ?
 Mn_2O_7 , CrO_3 , Cr_2O_3 , V_2O_5 .
West Bengal Board-2019
92. (i) Explain why most of the $Cu(I)$ compounds are unstable in aqueous solution.
 (ii) What happens when MnO_4^{2-} ion is kept in acid medium ? Write balanced equation.
West Bengal Board-2019
93. Complete and balance the following chemical equations.
 (a) $K_2MnO_4 + O_3 + H_2O \rightarrow$
 (b) $KMnO_4 + H_2O + KI \rightarrow$
 (Alkaline)
 (c) $Cr_2O_7^{2-} + SO_2 + H^+ \rightarrow$
 (d) $K_2Cr_2O_7 + NaCl + H_2SO_4 \rightarrow$
 (conc)
NIOS Board-2023
94. Explain giving reasons transition metals and their many compounds act as good catalyst.
Haryana Board-2021
95. a) On what ground can you say that Scandium ($Z = 21$) is a transition element but Zinc ($Z = 30$) is not?
 b) Which element of 3d series has more number of unpaired electrons in the ground state?
Karnataka Board-2020
96. a) 3d-series elements exhibit variable oxidation states.
 Why?
 b) Calculate the magnetic moment of Mn^{2+} ion. [Atomic number of Mn = 25] (1 + 2)
Karnataka Board-2015
97. Using VBT, explain the geometry, hybridization and magnetic property.
Karnataka Board-2016
98. a) Cu ions are coloured but Zn ions are colourless. Give reaction.
 b) Write the formula to calculate spin only magnetic moment.
Karnataka Board-2016
99. a) Give any two reasons for the formation of large number of complex compounds by transition metals.
 b) Write the formula to calculate spin only magnetic moment.
Karnataka Board-2017
100. a) Transition metals show catalytic property. Give two reasons.
 b) Between $Cu^{2+}_{(aq)}$ and $Cu^{+}_{(aq)}$ which is more stable.
Karnataka Board-2018
101. a) Calculate the spin only magnetic moment Tr^{3+} ion (Atomic number of Ti = 22).
 b) Cu^{2+} salt Solutions are coloured Give reason.
Karnataka Board-2019
102. Transition metals and their compounds are generally found to be good catalysts. Explain.
Haryana Board-2016
103. Give reasons for the following :
 (a) Transition metals and many of their compounds act as catalyst.
 (b) Scandium ($Z = 21$) does not exhibit variable oxidation state and yet it is regarded as a transition element.
 (c) Write the step involved in the preparation of Na_2CrO_4 from chromite ore.
Kerala Board-2018
104. Answer either (a) or (b):
 (a) (i) Actinoid contraction is greater from element to element than lanthanide contraction. Why?
 (ii) What are interstitial compounds?
 (iii) Calculate the number of unpaired electrons in the gaseous ion Cr^{3+} .
Assam Board-2014
105. Explain why Cu^+ ion is not stable in aqueous solution.
Haryana Board-2017
106. How would you account for the following?
 (i) Transition metal acts as good catalysts.
 (ii) Transition metal forms colored compounds.
Haryana Board-2017
107. Explain the magnetic behavior of transition metals.
Haryana Board-2017
108. Why is Cu_2I_2 colourless ? Calculate the magnetic moment (spin only) value of the trivalent ion of element with atomic number 22.
Manipur Board-2019
109. Give reason for
 (a) The first ionization enthalpy of chromium is very low but the second ionization enthalpy is very high.
 (b) Titrimetric analysis with potassium permanganate is carried out in the presence of acid. However hydrochloric acid is not used in such titrations.
Manipur Board-2022

110. Draw the structure of dichromate ion.
Given below are the transition metal ions of 3d series:
 Zn^{+2} , Cu^{+2} , Cr^{+3} , Sc^{+2}
(a) Select the ion which is colourless, giving the reason.
(b) Select the ion which is most paramagnetic, giving the reason.
- Goa Board-2019
111. Draw the structure of chromate ion.
Given below are the transition metals of 4d and 5d series:
 Zr , Mo , Hf , Cd
(a) Select the softest metal, giving the reason.
(b) Select the pair of metals which occur together as minerals, giving the reason.
- Goa Board-2019
112. Discuss enthalpy of atomization of d-Block elements.
- Haryana Board-2016
113. Transition metals are form Interstitial compounds Explain.
- Haryana Board-2018
114. Why transition metals form interstitial compounds?
- Haryana Board-2018
- 115.(a) Why transition elements form interstitial compounds?
(b)The atomic radii of lanthanide elements decreases on moving from left to right. Explain.
- Rajasthan Board-2020
116. Calculate the value of magnetic moment of V^{+2}
- Rajasthan Board-2017
117. Explain colour and complex formation tendency of transition metal ions?
- Rajasthan Board-2016
118. Calculate the 'Spin only' magnetic moment of M^{2+} (aq) ion ($Z = 29$).
- Rajasthan Board-2015
119. Silver atom has completely filled d-orbitals ($4d^{10}$) in its ground state, even then it is a transition element. How?
- Rajasthan Board-2014
120. Zn, Cd and Hg are not regarded as transition elements. Given reason.
- Rajasthan Board-2013
121. What is the shape of chromate ion? Draw its structure.
- Rajasthan Board-2013
122. Ti^{4+} ion is colourless. Give reason.
- Rajasthan Board-2013
123. Transition elements form complex compounds. Give two reasons.
- Rajasthan Board-2011
124. The atomic sizes of Fe, Co and Ni are same. Explain with reason.
- Rajasthan Board-2011
125. Answer the following:
(ii) Cu(I) has d^{10} configuration, while Cu(II) had d^9 configuration. Still Cu(II) is more stable in aqueous solution than Cu(I). Why?
- Assam Board-2020
126. Answer the following:
(ii) Zn^{2+} salts are colourless while Cu^{2+} salts are coloured Why?
- Assam Board-2020
127. Why is Cr^{2+} reducing and Mn^{3+} oxidizing when both have d^4 configuration?
- Assam Board-2020
128. Transition metals and its compounds in solid state have catalytic property. Explain in short.
- Gujarat Board-2019
129. Copper does not dissolve in HCl while it does dissolve in HNO_3 .
- Assam Board-2019
130. Zn^{2+} salts are colourless while Cu^{2+} salts are coloured. Give reason.
- Assam Board-2019
131. Aqueous solution of Ti^{4+} is colourless, but aqueous solution of Ti^{3+} is violet in colour. Explain.
- Assam Board-2016
132. Copper (I) had d^{10} configuration, while Copper (II) has d^9 configuration. Still Copper (II) is more stable in aqueous solution than Copper (I). Why?
- Assam Board-2016
133. Explain the following:
(i) Transition metals and their compounds can act as catalyst.
(ii) In the titration of $FeSO_4$ with $KMnO_4$ in acidic medium, dilute HCl is not used.
- Assam Board-2015
134. (a) How would you account for the following?
(i) Transition metals and many of their compounds show paramagnetic behavior.
(ii) The enthalpies of atomization of the transition metals are high.
(iii) The transition metal compounds are good catalyst.
(b) How potassium permanganate is prepared? Give necessary chemical equations.
- Assam Board-2013
135. Ionic radii of Fe^{2+} is less than ionic radii of Mn^{2+} . Why?
- MP Board-2018
136. What are inner transition elements.
- MP Board-2017
137. Transition elements are good catalysts explain.
- MP Board-2017
138. Explain the following:
(i) Cu^+ is colourless and Cu^{2+} is coloured
(ii) Zn shows only +2 oxidation state.
- MP Board-2013

Section-D : Case Based Study

1. (i) Account for the following:
 (1) Zn^{2+} salts are colourless while Ni^{2+} salts are coloured
 (2) Cr^{2+} is a strong reducing agent.
 (3) Transition metals and their compounds show catalytic activities.
- (ii) Write the ionic equations for the oxidizing action of MnO_4^- in acidic medium with
 (1) I^- ion, and
 (2) Fe^{2+} ion
- Gujarat Board 2023 (July)
2. (a) Predict which of the following will be coloured in aqueous solution and why?
 Ti^{3+} , V^{3+} , Cu^+ , Sc^{3+} , Mn^{2+} , Fe^{3+} , Co^{2+}
 (b) Write the balanced ionic equations for the following reactions:
 (i) $MnO_4^- + H^+ + S^{2-} \longrightarrow$
 (ii) $MnO_4^- + H^+ + Fe^{2+} \longrightarrow$
- CBSE-2019
3. Give reasons:
 (a) Why are Zn, Cd and Hg normally not regarded as transition metals?
 (b) Why is first ionization enthalpy of Cu is higher than that of Na?
 (c) Name one ore each of manganese and chromium.
 (d) Why is HCl not used to acidify a permanganate solution in volumetric estimation of Fe^{2+} or $C_2O_4^{2-}$?
 (e) What is lanthanoid contraction?
- Assam Board-2013

Section-E : Long Answer

1. Read the given passage and answer the questions number 1 to 5 that follow :
 The d-block of the periodic table contains the elements of the groups 3 – 12 and are known as transition elements. In general, the electronic configuration of these elements is $(n - 1)d^{1-10} ns^{1-2}$. The d-orbitals of the penultimate energy level in their atoms receive electrons giving rise to the three rows of the transition metals i.e., 3d, 4d and 5d series. However, Zn, Cd and Hg are not regarded as transition elements. Transition elements exhibit certain characteristic properties like variable oxidation states, complex formation, formation of coloured ions and alloys, catalytic activity, etc. Transition metals are hard (except Zn, Cd and Hg) and have a high melting point.
2. Why are Zn, Cd and Hg non-transition elements ?
- CBSE-2020
3. Which transition metal of 3d series does not show variable oxidation states ?
- CBSE-2020
4. Why do transition metals and their compounds show catalytic activity ?
- CBSE-2020
5. Why are melting points of transition metals high ?
- CBSE-2020
6. Why is Cu^{2+} ion coloured while Zn^{2+} ion is colourless in aqueous solution ?
- CBSE-2020
7. Account for the following:
 (a) The radius of Fe^{2+} is less than that of Mn^{2+}
 (b) Chromium is a typical hard metal while mercury is liquid
 (c) Co (II) is easily oxidized in the presence of strong ligand
 (d) It is not advisable to use HCl in $KMnO_4$ titrations
 (e) When H_2S is passed through a dilute solution of $K_2Cr_2O_7$, milkiness appears.
- CBSE-2019
8. (i) How do you prepare
 (a) K_2MnO_4 from MnO_2 ?
 (b) $Na_2Cr_2O_7$ from Na_2CrO_4 ?
 (ii) Account for the following:
 (a) Mn^{2+} is more stable than Fe^{2+} towards oxidation to +3 state.
 (b) The enthalpy of atomization is lowest for Zn in 3d-series of the transition elements.
 (c) Actinoid elements show wide range of oxidation states.
- Delhi 2014
9. (i) Account for the following:
 (a) Transition metals show variable oxidation states.
 (b) Zn, Cd and Hg are soft metals.
 (c) E° value for the Mn^{3+}/Mn^{2+} couple is highly positive (+ 1.57 V) as compared to Cr^{3+}/Cr^{2+} .
 (ii) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements.
- All India 2017
10. Explain the following observations:
 (i) In general, the atomic radii of transition elements decrease with atomic number in a given series.
 (ii) The $E^\circ_{M^{2+}/M}$ for copper is positive (+ 0.34 V). It is only metal in the first series of transition elements showing this type of behaviour.
 (iii) The E° value for Mn^{3+} / Mn^{2+} couple is much more positive than Cr^{3+} / Cr^{2+} or Fe^{3+} / Fe^{2+} couple.
- Delhi 2009
11. (i) Give reasons for the following observations.
 (a) Cu^+ ion is not stable in aqueous solution.
 (b) Mn (II) ion shows maximum paramagnetic character amongst the bivalent ions of first transition series.
 (c) Scandium ($Z = 21$) salts are white.
 (ii) Describe the reactions involved in the preparation of $K_2Cr_2O_7$ from chromite ore.
- Delhi 2009C

12. (i) Describe the following characteristics of the first series of the transition metals and their trends in the series (Sc to Zn).
 (a) atomic radii
 (b) oxidation states
 (c) ionization enthalpies
 (ii) What is meant by disproportionation reaction? Give an example of disproportionation reaction in an aqueous solution.
- All India 2009C
13. (i) What may be possible oxidation states of the transition metals with the following d-electronic configurations in the ground state of their atoms $3d^3 4s^2$, $3d^5 4s^2$ and $3d^6 4s^2$. Indicate relative stability of oxidation states in each case.
 (ii) Write steps involved in the preparation of
 (a) Na_2CrO_4 from chromite ore and
 (b) K_2MnO_4 from pyrolusite ore.
- Delhi 2008
14. Assign reasons for the following:
 (i) The enthalpies of atomization of transition elements are high.
 (ii) The transition metals and many of their compounds act as good catalysts.
 (iii) The E° value for the Mn^{3+} / Mn^{2+} couple is much more positive than that for Cr^{3+} / Cr^{2+} .
 (iv) Scandium ($Z = 21$) does not exhibit variable oxidation states and yet it is regarded as transition element.
- Delhi 2008
15. (i) Give reasons for the following:
 (a) Mn^{3+} is a good oxidising agent.
 (b) $E_{M^{2+}/M}^\circ$ values are not regular for first row transition metals (3d-series).
 (c) Although F is more electronegative than O, the highest Mn fluoride is MnF_4 , whereas the highest oxide is Mn_2O_7 .
 (ii) Complete the following equations:
 (a) $2CrO_4^{2-} + 2H^+ \longrightarrow$
 (b) $KMnO_4 \xrightarrow{\text{Heat}}$
- All India 2013
16. (i) Complete and balance the following chemical equations:
 (a) $Cr_2O_7^{2-} + I^- + H^+ \longrightarrow$
 (b) $MnO_4^- + SO_3^{2-} + H^+ \longrightarrow$
 (ii) Explain the following observations:
 (a) Transition elements and their compounds are known to act as catalysts.
 (b) The higher oxidation states are usually exhibited by the members in the middle of a series of transition elements.
 (c) The metal-metal bonding is more frequently found in the second and third series of transition elements.
- Foreign 2012
17. (i) Calculate the number of unpaired electrons in the following gaseous state ions. Mn^{3+} , Cr^{3+} , V^{3+} and Fe^{2+} Which one of these is the most stable in aqueous solutions?
 (Atomic number of V = 23, Cr = 24, Mn = 25, Fe = 26)
 (ii) Explain the following observations:
 (a) The transition metal ions are usually coloured in aqueous solutions.
 (b) $Cu(I)$ ion is not stable in a aqueous solution.
 (c) The highest oxidation state of a transition metal is exhibited in its oxide or fluoride.
- Foreign 2012
18. (a) State the reasons of the following.
 (i) MnO is basic while Mn_2O_7 is acidic.
 (ii) Transition metals show high melting and boiling points.
 (iii) Zn, Cd and Hg are not regarded as transition metals.
 (iv) Transition elements show variable oxidation states.
 (b) An orange coloured compound 'A' of chromium when heated with NaCl in presence of conc. H_2SO_4 gives red vapours of compound 'B'. Identify the compounds 'A' and 'B' and write chemical equations involved.
- NIOS Board-2019
19. (a) Complete and balance the following chemical equations:
 (i) $CrO_7^{2-} (aq) + H_2S(g) + H^+ (aq) \rightarrow$
 (ii) $MnO_2(s) + KOH (aq) + O_2 \rightarrow$
 (b) Transition elements exhibit variable oxidation states? Explain, why ?
- NIOS Board-2019
20. (a) When a ore A of manganese is fused with KOH in the presence of air to give a green-coloured compound, this green-coloured compound reacts with O_3 to give a purple-coloured compound B. Identify the compounds A and B and also give chemical equation.
 (b) Write down the reactions of XeF_2 and XeF_6 with water.
- NIOS Board-2016
21. (a) (i) What is the state of hybridization of the central oxygen atom in O_3 molecule ?
 (ii) Define 'transition elements'.
 (b) Explain the type of hybridization and magnetic behavior of the complex $[Co(NH_3)_6]^{3+}$. [Given, atomic number of Co = 27]
- NIOS Board-2012
22. Explain giving reasons -
 (i) Transition metals and many of their compounds show paramagnetic behaviour.(1)
 (ii) The enthalpies of atomisation of the transition metals are high. (2)
 (iii) the transition metals generally form coloured compounds (2)
 (iv) n-butyl chloride is treated with alcoholic KOH

- | | |
|---|--|
| <p>(v) bromobenzene is treated with Mg in the presence of dry ether</p> <p>(vi) ethyl chloride is treated with aqueous KOH act as good catalyst.</p> <p>(vii) methyl bromide is treated with sodium in the presence of dry ether ngly oxidis</p> <p>(viii) methyl chloride is treated with KCN?</p> <p>(x) The d¹ configuration is very unstable in ions (1)</p> | <p>31. Explain :</p> <ul style="list-style-type: none"> (a) Transition elements mostly form the complex compound. Why? (b) Transition elements are good catalyst. Why? (c) Transition elements show variable valency. Why? <p>MP Board-2014</p> |
| <p>23. (i) Scandium (z = 21) is a transition element but zinc (z = 30) is not. Explain</p> <p>(ii) Calculate equivalent weight of KMnO₄ in acidic medium.</p> <p>(iii) What do you mean by Lanthanoid contraction ?</p> | <p>Punjab Board-2021</p> <p>24. (a) Why are Mn²⁺ compounds more stable than Fe²⁺ towards oxidation to their +3 state.</p> <p>(b) What are interstitial compounds ? Why are such compounds well-known for transition metals ?</p> <p>(c) Write electronic configuration of Pm³⁺.</p> |
| <p>25. (a) What are Transition Elements ? Write their general electronic configuration.</p> <p>(b) With the help of electronic configurations of Cu⁺ and Cu⁺² explain which one is more paramagnetic.</p> | <p>Haryana Board-2019</p> <p>26. Transition metals are well known to form complex compounds, why? Explain with a example.</p> |
| <p>27. What are interstitials compounds. Give their general characteristics.</p> | <p>Chhattisgarh Board-2022</p> <p>28. Transition metals and their compound show paramagnetic behavior. Explain.</p> |
| <p>29. Which of the 3d series of the transition metals exhibits the largest number of oxidation states and why?</p> | <p>Haryana Board-2016</p> <p>30. Compare the chemistry of Actinoids with that of the Lanthanoids with special reference to</p> <ul style="list-style-type: none"> (i) electronic configuration (ii) oxidation state (iii) atomic and ionic sizes. <p>(a) Zn²⁺ salts are colourless while Cu²⁺ salts are coloured Give reason.</p> <p>(b) Complete the following reaction equation:</p> <p>(i) Cr₂O₇²⁻ + Sn²⁺ + H⁺ →</p> <p>(ii) MnO₄⁻ + Fe²⁺ + H⁺ →</p> |
| <p>31. Explain :</p> <ul style="list-style-type: none"> (a) Transition elements mostly form the complex compound. Why? (b) Transition elements are good catalyst. Why? (c) Transition elements show variable valency. Why? <p>MP Board-2014</p> | <p>32. Give reasons:</p> <ul style="list-style-type: none"> (a) Why do transition elements form Alloys? (b) What is the cause of Lanthanide contraction? <p>MP Board-2012</p> |
| <h2>D. The Lanthanoids</h2> | |
| Section-A : Multiple Choice Questions | |
| <p>1. Which oxidation state is common for lanthanoid elements?</p> <ul style="list-style-type: none"> (a) +5 (b) +3 (c) +4 (d) +2 | |
| <p>Gujarat Board 2023 (March)</p> | |
| <p>Ans. (b)</p> | |
| <p>2. Which of the following lanthanoid ions in solution is a good oxidizing agent?</p> <ul style="list-style-type: none"> (a) Eu²⁺ (b) Yb²⁺ (c) Sm²⁺ (d) Tb⁴⁺ | |
| <p>Manipur Board 2023</p> | |
| <p>Ans. (d)</p> | |
| <p>3. —form Oxo canons.</p> <ul style="list-style-type: none"> (a) Lanthanides (b) Actinides (c) Noble gases (d) Alkali metals | |
| <p>Tamil Nadu Board-2015</p> | |
| <p>Ans. (b)</p> | |
| <p>4. Alloys of Lanthanides are called as</p> <ul style="list-style-type: none"> (a) Mish metals (b) Metalloids (c) Plate metal (d) actinides. | |
| <p>Tamil Nadu Board-2011</p> | |
| <p>Ans. (a)</p> | |
| <p>5. Lanthanide contraction is due to</p> <ul style="list-style-type: none"> (a) perfect shielding of 4f electrons (b) imperfect shielding of 4f electrons (c) perfect shielding of 3d electrons (d) imperfect shielding of 3d electrons. | |
| <p>Tamil Nadu Board-2011</p> | |
| <p>Ans. (b)</p> | |
| <p>6. Lanthanoid contraction is due to increase in :</p> <ul style="list-style-type: none"> (a) atomic numbers (b) size of 4f orbital (c) shielding by f electrons (d) effective nuclear charge | |
| <p>NIOS Board-2022</p> | |

D. The Lanthanoids

Section-A : Multiple Choice Questions

1. Which oxidation state is common for lanthanoid elements?

(a) +5 (b) +3
(c) +4 (d) +2

Gujarat Board 2023 (March)

Ans. (b)

2. Which of the following lanthanoid ions in solution is a good oxidizing agent?

(a) Eu²⁺ (b) Yb²⁺
(c) Sm²⁺ (d) Tb⁴⁺

Manipur Board 2023

Ans. (d)

3. _____-form Oxo canons.

(a) Lanthanides
(b) Actinides
(c) Noble gases
(d) Alkali metals

Tamil Nadu Board-2015

- Ans. (b)**

4. Alloys of Lanthanides are called as
(a) Mish metals
(b) Metalloids
(c) Plate metal
(d) actinides.

Tamil Nadu Board-2011

Ans. (a)

5. Lanthanide contraction is due to
(a) perfect shielding of 4f electrons
(b) imperfect shielding of 4f electrons
(c) perfect shielding of 3d electrons
(d) imperfect shielding of 3d electrons.

Tamil Nadu Board-2011

- Ans. (b)**

6. **Lanthanoid contraction is due to increase in :**

 - (a) atomic numbers
 - (b) size of 4f orbital
 - (c) shielding by f electrons
 - (d) effective nuclear charge

NIOS Board-2022

Assam Board-2012

Ans. (d)

7. The radioactive lanthanide among the following is:
- Promethium
 - Lutetium
 - Cerium
 - Gadolinium

Tamil Nadu Board-2018

Ans. (a)

8. Trivalent ion of which of the following lanthanide metals is colourless?
- | | |
|--------|--------|
| (a) La | (b) Ce |
| (c) Pr | (d) Nd |

Manipur Board-2022

Ans. (a)

9. The most common oxidation state of Lanthanides is:
- | | |
|--------|--------|
| (a) +2 | (b) +1 |
| (c) +3 | (d) +4 |

Tamilnadu Board, Sep.-2016

Ans. (c)

10. Lanthanides are extracted from:
- | | |
|---------------|-----------------|
| (a) Limonite | (b) Monazite |
| (c) Magnetite | (d) Cassiterite |

Tamilnadu Board, March-2016

Ans. (b)

11. Which of the following statements is incorrect?
- Ce(OH)_3 is the least basic among the hydroxides of Lanthanoids
 - The ionic size decreases as we move from Ce^{3+} to Lu^{3+} .
 - The atomic radius decreases as we move from Ce to Lu.
 - The stable oxidation state of all Lanthanoids is (+3).

Gujarat Board-2018

Ans. (a) :

12. Which compound is used to produce very low temperature by magnetic effect?
- | | |
|------------------------------|----------------------------------|
| (a) Gd_2SO_4 | (b) $\text{Gd}_2(\text{SO}_4)_3$ |
| (c) GdSO_4 | (d) GdS |

Gujarat Board-2018

Ans. (b)

13. If coordination number of Cs^+ is 8 in CsCl then coordination number of Cl^- ion is—
- | | |
|-------|--------|
| (a) 8 | (b) 4 |
| (c) 6 | (d) 12 |

MP Board-2017

Ans. (a)

Section-B : Very Short Answer

1. Give two examples of lanthanoid elements. Also write their two main uses.

UP Board 2019

2. Name a member of Lanthanoid series which is well-known to exhibit +4 oxidation state.

Gujarat Board 2023 (July)

3. What is Lanthanide contraction? Mention any two consequences of it.

Karnataka board 2023

4. What is Lanthanide contraction ? What is the cause of Lanthanide contraction ? Write two consequences of Lanthanide contraction.

CBSE-2022

5. What is Lanthanide contraction ? Write its two consequences.

CBSE-2022

6. State the common oxidation state of
- | |
|-----------------|
| (a) lanthanoids |
| (b) actinoids |

ISC Board-2011

7. What is Lanthanide contraction? What are the consequences of Lanthanide contraction?

Delhi 2015C

8. Write one similarity and one difference between the chemistry of lanthanoids and that of actinoids.

All India 2015

9. What is Lanthanide contraction? What are its two consequences?

Delhi 2014C, 2013C

10. What is Lanthanide contraction? List any two consequences of lanthanide contraction.

All India 2009C, 2008C

11. What is Lanthanide contraction? What is its effect on the chemistry of the elements which follow the lanthanoids?

All India 2011; Delhi 2009

12. Write the electronic configuration of Ce^{3+} ion and calculate the magnetic moment on the basis of spin-only formula. (Atomic number of Ce = 58)

All India 2010C

13. Name an important alloy which contains some of the lanthanoid metals. Mention its two uses.

Delhi 2009C

14. Why is europium (II) more stable than cerium (II)?

All India 2010

15. Why do actinoids in general exhibit a greater range of oxidation states than the lanthanoids?

Foreign 2009; Delhi 2009

16. La^{3+} ($Z = 57$) and Lu^{3+} ($Z = 71$) do not show any colour in solutions. Give reason.

All India 2010

17. Lanthanum and lutetium do not show colouration in solution. Give reason

Foreign 2010

18. Name a member of the lanthanoid series which is well known to exhibit +2 oxidation state.

Delhi 2014

19. What are the different oxidation states exhibited by the lanthanoids?

Foreign 2014

20. $\text{Zr}(Z = 40)$ and $\text{Hf}(Z = 72)$ have almost identical radii. Give reason.

Delhi 2013

21.	How would you account for the following? Lanthanoids form primarily +3 ions, while the actinoids usually have higher oxidation states in their compounds, +4 or even +6 being typical. Delhi 2012	3.	Why do actinoids show larger number of oxidation states as compared to the lanthanoids? Manipur Board 2023
22.	How would you account for the following? Among lanthanoids, Ln (III) compounds are predominant. However, occasionally in solutions or in solid compounds, +2 and +4 ions are also obtained. All India 2012	4.	(a) Account for the following: (i) Transition metals and their compounds act as good catalysts. (ii) Eu ²⁺ is a strong reducing agent. (iii) Chromium is hard whereas Zinc is soft metal. CBSE-2022
23.	Explain the following observation: The members of the actinoid series exhibit a larger number of oxidation states than the corresponding members of the lanthanoid series. All India 2012; foreign 2010; Delhi 2009	5.	What is Lanthanide contraction ? Write two consequences of Lanthanide contraction. CBSE-2022
24.	The metallic radii of the third (5d) series of transition metals are virtually the same as those of the corresponding group member of the second (4d) series. Give reason. Delhi 2012; all India 2012, 2009	6.	(a) Account for the following: (i) Transition elements have higher enthalpies of atomization. (ii) Separation of a mixture of Lanthanoid elements is difficult. (iii) The E° _{M²⁺/M} value for copper is positive. CBSE-2022
25.	What is meant by 'lanthanoid contraction'? All India 2011	7.	(i) Which is the most common oxidation state in Lanthanoids ? (ii) Why is there a gradual decrease in the atomic sizes of transition metals in a series with increasing atomic numbers ? (iii) Calculate the number of unpaired electrons in the following gaseous ions : V ³⁺ , Ti ³⁺ CBSE-2022
26.	What is lanthanoid contraction? Write two of its consequences. Odisha Board-2020	8.	(a) Write any two consequence of Lanthanide Contraction. (b) Name the element of 3d series which exhibits the largest number of oxidation states. Give reason. CBSE-2022
27.	What do you mean by lanthanide contraction? Mention its causes and consequences. Odisha Board-2023	9.	Answer the following: (a) What is the general electronic configuration of lanthanoids? (b) What are the common oxidation states of Cerium (At. no. 58)? (c) Why do actinoids show a wide range of oxidation states? CBSE-2019
28.	What is lanthanoid contraction and what are the consequences of it? Manipur Board-2018	10.	What is Lanthanide contraction ? Discuss its causes and consequences. Tamil Nadu Board-2015
29.	What is lanthanide contraction? Mention the cause for it. Karnataka Board-2017	11.	Write the uses of lanthanides and actinides. Tamil Nadu Board-2018
30.	What is Lanthanide contraction? Mention one of its consequences. Karnataka Board-2014	12.	(a) Give two differences between Lanthanoids and Actinoids. (b) How many unpaired electrons are present in Fe ⁺³ and Zn ⁺² . (c) Why La (OH) ₃ is stronger base while Lu(OH) ₃ is weaker base ? Punjab Board-2019
31.	What is lanthanoid contraction? Write the general oxidation state of actinoids. Karnataka Board-2016		
32.	a) What is Lanthanoid contraction? b) What is the general oxidation state shown by actinoids? Karnataka Board-2018		
33.	What are lanthanoids? Assam Board-2016		
34.	a. Compare two properties of lanthanoids and actinoids. Nagaland Board-2018		

Section-C : Short Answer

- Give four differences between Lanthanides and Actinides.

MP Board 2020
- What do you understand by lanthanoid contraction?

Rajasthan Board 2022

13. (a) Give preparation of Potassium Permanganate ($KMnO_4$).
 (b) What is Lanthanide contraction, give its cause.
 (c) Transition metals show catalytic properties, Explain.
- Punjab Board-2019
14. Explain lanthanide contraction.
- Gujarat Board-2019
15. (i) What is lanthanide contraction ?
 (ii) Explain the cause of lanthanide contraction.
- Maharashtra board-2018
16. What is Lanthanide contraction ?
 Write preparation of acetic acid from
 (a) dry ice
 (b) acetyl chloride
- Maharashtra board-2022
17. What are the different oxidation states exhibited by Lanthanoids?
- Jharkhand Board-2019
18. What is Lanthanide contraction? Write two causes and two consequences of Lanthanide contraction.
- Chhattisgarh Board-2021
19. What is Lanthanide contraction ? Mention any one of its consequences.
- Kerala Board-2022
20. (a) What are transition elements? Write the electronic configuration of Cr(24) & Cu(29)
 (b) Write a note on lanthanide contraction.
- Haryana Board-2017
21. Fourteen elements following Lanthanum are called Lanthanoids :
 (a) What is Lanthaniod contraction? Give reason for it.
 (b) $KMnO_4$ is a purple coloured crystal and it acts as an oxidant. How will you prepare $KMnO_4$ from MnO_2 ?
- Kerala Board-2015
22. Write general oxidation state of Lanthanoids.
- Rajasthan Board-2018
23. What is Lanthanide contraction ?
- Rajasthan Board-2015
24. What is lanthanide contraction? Explain it.
- Rajasthan Board-2010
25. Differentiate Lanthanides and Actinides.
- Tamilnadu Board, March-2016
26. Answer the following:
 (i) Use Hund's rule to derive the electronic configuration of Ce^{3+} ion and calculate its magnetic moment.
- Assam Board-2020
27. Answer the following:
 (i) What is lanthanide contraction? Why actinide contraction is greater from element to element than lanthanide contraction?
- Assam Board-2020
28. Explain Lanthanoid contraction.
- Gujarat Board-2020
29. What is lanthanide contraction? How is it caused?
- MP Board-2018
30. Write three differences between Lanthanides and Actinides.
- MP Board-2017
31. (a) What are Lanthanide elements?
 (b) What do you understand by Lanthanide contraction?
 (c) Write chromyl chloride test with equation.
- MP Board-2016
32. (a) Why Transition elements become paramagnetic?
 (b) Explain oxidization properties of potassium permanganate in acidic medium. (any four only)
- MP Board-2016
33. Name the element in the lanthanoids series which has +4 oxidation state. Why do transition metal form interstitial compounds ?
- Nagaland Board-2021
- 34.(a) Explain why Ce^{4+} is a good oxidizing agent whereas Sm^{+2} is a good reducing agent.
- Meghalaya Board-2018

Section-D : Case Based Study

1. Read the given paragraph and give answers of the following questions.
 The rare earth elements of the modern periodic table are known as lanthanoids. They have separate block in periodic table. The lanthanoid series consists of fourteen elements starting from Cerium (atomic number-58) to Lutetium (atomic number-71). All lanthanoids generally exhibit +3 oxidation state. In addition some lanthanoids show +2 and +4 oxidation state also. As we move from left to right in lanthanoid series there is regular decrease in the size of an atom. This is known as lanthanide contraction. There are many industrial application as formation of mischmetal, production of parts of Jet engine.
- (A) The basic nature of hydroxides of lanthanoid elements decreases moving from left to right. Explain.
 (B) Write name of two lanthanoid elements used in the formation of mischmetal.
 (C) Write the name of any one lanthanoid element exhibiting +4 oxidation state.
- Rajasthan Board-2019

Section-E : Long Answer

2. (i) With reference to structural variability, chemical reactivity, write the differences between lanthanoids and actinoids.
 (ii) name a member of the lanthanoid series which is well known to exhibit +4 oxidation state.
 (iii) Complete the following equation:
- $$MnO_4^- + 8H^+ + 5e^- \longrightarrow$$

- (iv) Out of Mn^{3+} and Cr^{3+} , which is more paramagnetic and why?
(Atomic number of Mn = 25, Cr = 24)

Delhi 2014

3. Write any five differences between lanthanides and actinides.

Tamil Nadu Board-2011

4. (a) What is lanthanide contraction? How does it affect the chemistry of post- lanthanoid elements?
(b) Give the type of hybridization and magnetic behavior $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ complexes. [At. No. of Ni = 28]

NIOS Board-2016

5. (a) Write a reaction to show the oxidizing property of sulphuric acid.
(b) What is lanthanide contraction and what are its consequences?

NIOS Board-2011

6. (i) An orange-coloured compound 'A' of chromium when heated with sodium chloride in the presence of conc. H_2SO_4 gives red vapours of compound 'B'. When red vapours of 'B' passed into NaOH solution gives yellow colour solution of 'C'. Identify 'A', 'B' and 'C' and write the chemical reaction involved in change of A to B,
(ii) What is meant by Lanthanoid contraction? Write its one consequence.

NIOS Board-2023

7. Define Lanthanide contraction? What is its cause and what are its consequences? What is the most common oxidation state exhibited by lanthanides?

J&K Board-2019

8. (a) What are Lanthanides? Why is it difficult to separate them ? Explain.
(b) With the help of electronic configurations of Fe^{+2} and Fe^{+3} explain which one is more paramagnetic.

Chhattisgarh Board-2022

9. What is Lanthanide contraction? Give its two consequences?

Haryana Board-2016

10. What is Lanthanide contraction? Explain its reasons and consequences.

Haryana Board-2018

11. Describe the extraction of lanthanides from monazite sand.

Tamilnadu Board, Sep.-2016

12. Write any six differences between lanthanides and actinides.

MP Board-2015

13. Compare Lanthanide and Actinide. (Write any five points.)

MP Board-2013

14. What is lanthanide Contraction? Explain the cause of lanthanide contraction.

J & K Board-2021

15. (a) Write the reaction of $KMnO_4$ with Fe(II) ions in acidic medium.
(b) Define lanthanide contraction. Write two consequences of lanthanide contraction.

Meghalaya Board-2019

E. The Actionoids

Section-A : Multiple Choice Questions

1. The maximum oxidation state exhibited by actinides is:

 - (a) +7
 - (b) +5
 - (c) +4
 - (d) +8

Odisha Board-2023

Ans. (a)

Tamilnadu Board, March-2016

Ans. (d)

Gujarat Board-2018

Ans.(b) :

Section-B : Very Short Answer

1. State any four properties of d-block elements. **UP Board 2023**

2. (a) Actinoid contraction is greater than lanthanoid contraction. Give reason.
(b) Out of Fe and Cu, which has higher melting point and why ?

CBSE-2019

3. The gradual decrease in size (actinide contraction) from element to element is greater among the actinoids than that among the lanthanoids (lanthanide contraction).

Delhi 2009-2008

- Delhi 2003, 2008

Delhi 2008

- Desh 2008
5. Chemistry of the actinoids is much more complicated than that of lanthanoids. Give reason.

Delhi 2011C

6. The chemistry of actinoids is not so smooth as that of lanthanoids. Give reason.

All India 2011

7. Given reason:

 - a) Cerium (Ce) exhibits +4 oxidation state.
 - b) Actinoid contraction, is greater from element to element than lanthanoid contraction.

Karnataka Board-2018

- 8. Give reasons:**

 - i) Actinoids show variable oxidation states,
 - ii) Cerium (Ce) exhibits +4 oxidation state

Karnataka Board-2015

Some Applications of d-and-f Block Elements

Section-A : Multiple Choice Questions

1. Which of the following is a strong oxidizing agent?
(At. No. Mn = 25, Zn = 30, Cr = 24, Sc = 21)
(a) Mn^{3+} (b) Zn^{2+}
(c) Cr^{3+} (d) Sc^{3+}

CBSE-2021

Ans. (a)

- (a) Paramagnetic, diamagnetic
 (b) noble, paramagnetic
 (c) noble, diamagnetic
 (d) diamagnetic, paramagnetic
- ISC Board-2015**
- 6.** Use Hund's rule to derive the electronic configuration of Ce^{3+} ion and calculate its magnetic moment by using 'spin only' formula. (Atomic number of Ce = 58)
- All India 2008C
- 7.** Explain the following observation:
 Most of the transition metal ions exhibit characteristic colours in aqueous solutions.
- Delhi 2012
- 8.** Compounds of transition element are often coloured. Why?
- Delhi 2008C
- 9.** Which of following cations are coloured in aqueous solutions and why?
 $\text{Sc}^{3+}, \text{V}^{3+}, \text{Ti}^{4+}, \text{Mn}^{2+}$
 (At. no. Sc = 21, V = 23, Ti = 22, Mn = 25)
- Delhi 2013
- 10.** Explain: Capacity of transition elements to form complex compounds is more than that with other elements.
- Gujarat Board-2016
- 11.** Give reasons:
 i) Actinoids show variable oxidation state.
 ii) Zr and Hf have almost identical radii.
- Karnataka Board-2014
- 12.** Give two reasons. The chemistry of actinides is more complicated than Lanthanoids.
- Karnataka Board-2020
- 13.** How will you account for the following?
 i) Actionoids exhibit more number of oxidation states than lanthanoids.
 ii) Atomic radii of second and third transition series elements are almost identical.
- Karnataka Board-2019
- 14.** Give any two differences between lanthanoids and actinoids.
- Karnataka Board-2015
- 15.** a) Name a member of Lanthanoid series which is well known to exhibit +4 oxidation state.
 b) Actinoid contraction is greater from element to element than Lanthanoid contraction. Why?
- Karnataka Board-2020
- 16.** Distinguish between lanthanides and actinides.
- Maharashtra board-2023
- 17.** What is the structure of chromate ion (CrO_4^{2-})?
- Kerala Board-2018
- 18.** Why is Cr^{2+} reducing and Mn^{3+} oxidizing when both have d^4 configuration?
- Kerala Board-2022
- 19.** When HCl reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride. Why?
- Assam Board-2020
- 20.** Complete the following reactions:
 (ii) $4\text{NaCl} + \text{MnO}_2 + 4\text{H}_2\text{SO}_4 \rightarrow ?$
- Assam Board-2020
- 21.** Write the formula of Blue Vitriol
- MP Board-2015
- 22.** Calculate the spin only magnetic moment of Mn^{2+} (aq) ($Z = 25$).
- Meghalaya Board-2021
- 23.** Out of Cu^+ and Cu^{2+} , which ion is more stable in aqueous solution and why?
- Assam Board-2023
- 24.** (a) Give reason why zinc, cadmium and mercury are not regarded as transition elements.
- Nagaland Board-2021
- 25.** Why do the transition elements exhibit higher enthalpies of atomization?
- Nagaland Board-2021
- 26.** Calculate the magnetic moment of:
 (a) Sc^{3+} ($Z = 21$)
 (b) V^{3+} ($Z = 23$)
- Jharkhand Board-2023
- 27.** Why do transition elements form complexes?
- Nagaland Board-2018

Section-C : Short Answer

- 1.** How would you account for the following situations?
 (i) The transition metals generally form coloured compounds.
 (ii) With $3d^4$ configuration, Cr^{2+} acts as a reducing agent but Mn^{3+} acts as an oxidizing agent. (Atomic number of Cr = 24, Mn = 25)
- All India 2008
- 2.** Explain giving a suitable reason for each of the following:
 (i) Transition metals and their compounds are generally found to be good catalysts.
 (ii) Metal-metal bonding is more frequent for the 4d and 5d-series transition metals than that for the 3d-series.
- All India 2011, 2009
- 3.** Assign reasons for the following:
 (i) Transition metals and many of their compounds act as good catalysts.
 (ii) Transition metals generally form coloured compounds.
- All India 2014C
- 4.** How does copper metal react with ammonia? Given the reaction with the product formed.
- Odisha Board-2017
- 5.** On heating copper turning with con. H_2SO_4 a colourless gas with pungent order is evolved which decolorize KMnO_4 solution. Identify the gas and write its chemical reaction with KMnO_4 solution
- NIOS Board-2023
- 6.** How will you convert potassium chromate to potassium dichromate? Mention the colour change involved in the reaction.
- Tamil Nadu Board-2018

7. How Potassium permanganate is prepared from MnO_2 .
Karnataka Board-2016
8. (i) Account for the following :
 A. Zr and Hf have identical radii.
 B. Transition metals are very good catalysts
 (ii) Calculate the spin only magnetic moment of $M_{(aq)}^{2+}$ ion ($Z = 27$)
Kerala Board-2021
9. Why do actinides, in general, exhibit a greater range of oxidation states than the lanthanides.
Haryana Board-2016
10. Write any three applications of d- and f- block elements.
Kerala Board-2019
11. Give balanced equations for the following reactions:
 (i) Potassium permanganate is heated with concentrated hydrochloric acid
 (ii) Lead sulphide is heated with hydrogen peroxide.
ISC Board-2017
12. (a) In d-block elements the radii of elements of third transition series are similar to those of the elements of second transition series. Give reason.
 (b) Outer electronic configuration of Cu^{2+} ion is $3d^9$. Calculate its spin only magnetic moment.
Kerala Board-2020
13. (b) How does the acidified permanganate solution react with the following? Write the ionic equations for the reactions.
 (i) KI
 (ii) iron (II) ion
 (iii) oxalic acid
Assam Board-2014
14. Copper does not dissolve in HCl while it does dissolve in HNO_3 . Explain.
Assam Board-2014
15. Write note on interstitial compounds.
Haryana Board-2017
16. Draw the structure of MnO_4^-
Haryana Board-2017
17. Compare between transition and inner-transition elements. [3]
Uttarakhand Board-2019
18. What is the action of heat on $K_2Cr_2O_7$?
Tamilnadu Board, March-2016
19. State the reaction of C12 with cold, dilute NaOH and $KMnO_4$ with HCl.
Gujarat Board-2018
20. What happens when sulphur dioxide gas is passed through acidified potassium permanganate solution? Write equation.
Assam Board-2019
21. Give two uses of potassium permanganate.
Assam Board-2018
22. Give reason why HCl is not used to acidify $KMnO_4$ solution in volumetric determination of Fe^{2+} .
Assam Board-2017
23. Both Cu and Zn have completely filled 3d atomic orbital Cu is considered as transition element but Zn is not. Explain.
Assam Board-2012
24. How is $K_2Cr_2O_7$ prepared from chromite ore? Write with equation.
MP Board-2018
25. Describe the preparation of $KMnO_4$ from Pyrolusite with equation.
MP Board-2017
26. What happens when (Give Chemical equation only)
 (1) KI solution is added to $CuSO_4$ solution.
 (2) $CuSO_4$ solution reacts with NaOH.
 (3) $AgNO_3$ is heated.
 (d) $AgNO_3$ reacts with Ammonium hydroxide
MP Board-2015
27. What is Blue Vitriol? Write effect of heat on it
MP Board-2013
28. What happens when (give equation) :
 (a) Copper sulphate is heated upto $230^\circ C$ temperature?
 (b) Copper sulphate react with ammonium hydroxide?
 (c) Silver nitrate react with hydrochloric acid?
 (d) Mercuric chloride react with potassium iodide?
MP Board-2012
29. Give three oxidizing properties of $K_2Cr_2O_7$.
J & K board-2023
30. How d-Block elements form coloured ions?
Or
Why d-block elements show catalytic properties?
J & K board-2023
31. Explain the following :
 (i) Transition metals act as catalysts.
 (ii) Transition metals form coloured complexes.
J&K Board-2020
- 32.(a) Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.
 (b) Predict which of the following will be coloured in aqueous solution :
 Sc^{3+} , Fe^{3+} , Ti^{4+} , V^{3+}
 (Atomic nos. of Sc, Fe, Ti and V are 21, 26, 22 and 23 respectively)
Meghalaya Board-2019
33. (a) Name the only metal of the d-block elements which is a liquid at room temperature.
 (b) Write the exceptional electronic configurations of the elements Cr ($Z = 24$) and Cu ($Z = 29$).
 (c) Why scandium, Sc ($Z = 21$) is a transition element but zinc, Zn ($Z = 30$) is not?
Meghalaya Board-2021

34. Define atomization enthalpy. Arrange the following in increasing order of their atomization enthalpy. Mn, Fe, Zn
Assam Board-2023
35. (a) why are Zn^{2+} salts white while Cu^{2+} salts are blue ?
(b) What is meant by 'disproportionation' ? Write the disproportionation reaction of Cu^+ in aqueous solution.
Meghalaya Board-2018
36. You are supplied with a concentrated solution of Na_2CrO_4 . How will you obtain $K_2Cr_2O_7$ from this? write the equation involved.
Meghalaya Board-2018
- Section-E : Long Answer**
1. (a) Give reasons :
 (i) Transition metals and their compounds show catalytic activities.
 (ii) Separation of a mixture of Lanthanoid elements is difficult.
 (iii) Zn, Cd and Hg are soft and have low melting point.
 (b) Write the preparation of the following :
 (i) $Na_2Cr_2O_7$ from Na_2CrO_4
 (ii) K_2MnO_4 from MnO_2
CBSE-2020
2. (a) Account for the following :
 (i) Ti^{3+} is coloured whereas Sc^{3+} is colourless in aqueous solution.
 (ii) Cr^{2+} is a strong reducing agent.
 (b) Write two similarities between chemistry of lanthanoids and actinoids.
 (c) Complete the following ionic equatin :
 $3 MnO_4^{2-} + 4H^+ \rightarrow$
CBSE-2020
3. (a) Give three points of difference between lanthanoids and actinoids.
 (b) Give reason and select one atom/ion which will exhibit asked property.
 (i) Sc^{3+} or Cr^{3+} (Exhibit diamagnetic behaviour)
 (ii) Cr or Cu (High melting and boiling point)
CBSE-2020
4. (a) Write the preparation of $KMnO_4$ from pyrolusite ore (MnO_2).
 (b) Account for the following:
 (i) Transition metals form alloys
 (ii) Actinoids contraction is greater than lanthanoids
 (iii) Mn^{3+} is strongly oxidizing whereas Cr^{2+} is strongly reducing in nature.
CBSE-2020
5. (i) Name the element of 3d-transition series which shows maximum number of oxidation states. Why does it show so?
 (ii) Which transition metal of 3d-series has positive $E^\circ_{M^{2+}/M}$ value and why?
 (iii) Out of Cr^{3+} and Mn^{3+} , which is a stronger oxidising agent and why?
 (iv) Name a member of the lanthanoid series which is well known to exhibit +2 oxidation state.
 (v) Complete the following equation,
 $MnO_4^- + 8H^+ + 5e^- \longrightarrow$
All India 2014
6. Describe the preparation of potassium permanganate. How does the acidified permanganate solution react with oxalic acid? Write the ionic equations for the reactions.
Gujarat Board-2021
7. (i) What is blister copper ?
 (ii) With the help of electronic configuration of Fe^{2+} and Fe^{3+} , explain which one is more paramagnetic.
Chhattisgarh Board-2023
8. Write the formula of the following coordination entities :
 (a) Fe^{2+} ion is bound with six cyanide ions
 (b) Ni^{2+} ion is bound with four cyanide ions.
 Write the IUPAC name, type of hybridization and magnetic behavior of the above coordination entities.
 [Atomic No. : Fe = 26, Ni = 28]
NIOS Board-2019
9. A black coloured compound (X) of manganese when fused with KOH in the presence of air gave a green coloured compound (Y). When the compound (Y) was treated with an oxidising agent such as Cl_2 it gave a purple coloured solution (Z). When purple coloured solution (Z) reacts with acidified $FeSO_4$, purple colour disappears due to formation of compound (E). Identify X, Y, Z and E and write chemical equation involved.
NIOS Board-2023
10. Explain the following :
 (i) Although Lithium has the most negative E° value, its reaction with water is less vigorous than that of sodium with least negative E° in the group.
 (ii) Lithium shows properties similar to magnesium.
 (iii) Zr (Atomic Number 40) and Hf (Atomic Number 72) have almost same atomic radii.
 (iv) Transition elements are generally paramagnetic in nature.
NIOS Board-2021
11. Complete the following reactions :
 (a) $Al_2O_3 + 2NaOH \rightarrow$
 (b) $O_3 + 2FeSO_4 + H_2SO_4 \rightarrow$
 (c) $K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \rightarrow$
 (d) $6XeF_4 + 12H_2O \rightarrow$
NIOS Board-2021
12. What happens when (give balanced chemical equation)—
 (a) $K_2Cr_2O_7$ is heated with conc. H_2SO_4 and NaCl;
 (b) alkaline $KMnO_4$ reacts with KI?
NIOS Board-2018
13. Explain the following observations:
 (a) Generally there is an increase in density of elements from titanium to copper in the first series of transition elements.
 (b) Transition elements and their compounds are generally found to be good catalysts in chemical reactions.
NIOS Board-2016
14. Zinc reacts with hydrochloric acid according to the following chemical equation :
 $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
 If 6.5 g of zinc is added to 1 L of hydrochloric acid solution containing 3.65 g of HCl per litre, then find—
 (a) which is the limiting reagent ;
 (b) how many moles of H_2 will be formed;

- (c) how many moles of other substance will remain unconsumed at the end of the reaction.
[Atomic mass : H = 1.0u, Cl = 35.5u, Zn = 65.0u]
- NIOS Board-2014
15. (a) How does hydrogen peroxide decolourize potassium permanganate? Give chemical equation.
(b) Explain why oxygen exists as a gas whereas sulphur exists as a solid.
(c) Why does BCl_3 act as a Lewis acid?
(d) Write the name of the complex $(\text{NH}_4)_3[\text{Cr}(\text{NCS})_6]$.
- NIOS Board-2011
16. (i) Write down any three differences between Lanthanoids and Actinoids.
(ii) The melting and boiling points of Zr, Cd and Hg are low. Why?
(iii) Draw the structure of manganate ion.
- Punjab Board-2017
17. A black coloured compound [A] of manganese when fused with KOH under atmospheric oxygen gave a green coloured compound [B]. When compound [B] is treated with an oxidizing agent (chlorine), it gave a purple coloured compound [C]. When compound [C] is kept in water for a day it gave brown coloured compound [D]. Identify A, B, C and D and also write chemical equations.
- NIOS Board-2022
18. (a) Write ionic equations for the reaction of acidified potassium permanganate with following:
(a) Oxalic acid,
(b) H_2S ,
(c) Sulphite ion,
(b) Describe the reactivity of actinoids
- Haryana Board-2019
19. Give reasons for the following:
(a) There is a steady decrease in atomic or ionic radii of lanthanoids from Lanthanum to Lutetium.
(b) Transition elements exhibit catalytic properties.
(c) Paramagnetic character in the first transition series increases upto manganese and then decreases.
- Goa Board-2018
20. Explain the following
(a) Why transitional elements form coloured compounds?
(b) Why transitional elements form complex compounds?
- J&K Board-2019
21. Transition elements are d-block elements and inner transition elements are f-block element.
(a) Write any two properties of transition elements.
(b) Name a transition metal compound and write one use of it
(c) What is Lanthanide contraction?
(d) Write any two consequences of lanthanide contraction.
- Kerala Board-2016
22. Answers the following questions :
(i) Name any two elements of the d block which are not considered as transition elements.
(ii) Transition elements forms alloys. Write the reason.
(iii) $\text{Lu} + \text{H}_2\text{O} \rightarrow \text{X} + \text{H}_2$; identify X.
- Goa Board-2019
23. Write general electronic configuration of transition elements and explain their following properties:
(a) Magnetic property
(b) Catalytic property
- Chhattisgarh Board-2020
24. Explain preparation of potassium dichromate and write its ionic equation with the following:
(a) Iron
(b) H_2S
- Chhattisgarh Board-2020
25. Write the structure of $\text{Cr}_2\text{O}_7^{2-}$. Give two uses of $\text{K}_2\text{Cr}_2\text{O}_7$.
- Haryana Board-2017
26. Write the chemical reaction of KMnO_4 with:
(i) KI
(ii) H_2S
(iii) FeSO_4
- Haryana Board-2017
27. Write the chemical reaction of $\text{K}_2\text{Cr}_2\text{O}_7$ with following:
(i) H_2SO_4
(ii) KOH
(iii) KI
- Haryana Board-2017
28. Discuss five uses of d and f-block element.
- Haryana Board-2018
29. (a) What happens when acidified $\text{K}_2\text{Cr}_2\text{O}_7$ is reacted with?
(i) H_2S
(ii) KI
(iii) FeSO_4
- Haryana Board-2018
30. (a) Complete the following reactions:
(i) $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{Fe}^{2+} + \text{H}^+ \rightarrow$
(ii) $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{I}^- + \text{H}^+ \rightarrow$
(iii) $\text{MnO}_4^-(\text{aq}) + \text{Fe}^{2+} + \text{H}^+ \rightarrow$
- Haryana Board-2018
31. Describe the preparation of potassium permanganate. How does acidified KMnO_4 solution react with:
(i) SO_2
(ii) Oxalic acid
(iii) FeSO_4
- Haryana Board-2018
- Write ionic equations for these reactions.
32. Write any four applications of 'f'-block elements.
- Gujarat Board-2018
33. Give the chemical equation for the reaction between a saturated solution of sodium dichromate and potassium chloride.
- Assam Board-2016
34. Write any six main differences between d and f-block elements.
- MP Board-2014
35. (a) On the basis of valence bond theory, predict the shape, magnetic behaviour of $[\text{NiCl}_4]^{2-}$.
- Nagaland Board-2021
36. (b) Give the IUPAC name of $\text{K}_2[\text{Cr}(\text{C}_2\text{O}_4)_3]$. Predict the number of unpaired electrons in the square planar $[\text{Pt}(\text{CN}_4)]^{2-}$ ion.
- Nagaland Board-2021

15. Coordination compounds structure was first proposed by **ISC Board-2009**
16. When a coordination compound $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ is mixed with AgNO_3 , 2 moles of AgCl are precipitated per mole of the compound. Write
 (i) structural formula of the complex.
 (ii) IUPAC name of the complex. **Delhi 2014**
17. When a coordination compound $\text{CoCl}_3 \cdot 6\text{NH}_3$ is mixed with AgNO_3 , 3 moles of AgCl are precipitated per mole of the compound. Write
 (i) structural formula of the complex.
 (ii) IUPAC name of the complex. **Delhi 2016**
18. When a coordination compound $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ is mixed with AgNO_3 , 2 mole of AgCl are precipitated per moles of the compound write structural formula of the complex. **All India 2016**
19. When a coordination compound $\text{CoCl}_3 \cdot 6\text{NH}_3$ is mixed with AgNO_3 , 3 moles of AgCl are precipitated per mole of the compound. Write structural formula of the complex. **Foreign 2011**
20. What do you understand by denticity of a ligand? **Maharashtra board-2022**
21. Explain monodentate and ambidentate ligands with example. **Haryana Board-2016**
22. Define the following:
 (i) Coordination number
 (ii) Coordination sphere **Andhra Pradesh Board-2021**
23. Explain Werner's theory of coordination compounds with suitable examples. **Nagaland Board-2017**
24. What is an ambideterminate ligand? Give an example. **Karnataka Board-2014**
- Section-C : Short Answer**
25. (a) Give the IUPAC name and electronic configuration of central metal atom in terms of t_{2g} and e_g of $\text{K}_4[\text{Mn}(\text{CN})_6]$.
 (b) What is meant by 'Chelate effect'? Give an example. **CBSE-2020**
26. When a co-ordination compound $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ mixed with AgNO_3 , 2 moles of AgCl are precipitated per mole of the compound. Write
 (i) Structural formula of the complex.
 (ii) Secondary valency of 'Ni' in the complex.
 (iii) IUPAC name of the complex. **CBSE-2022**
27. Define the following :
 (a) Ambidentate ligands
 (b) Spectro chemical series
 (c) Heteroleptic complexes **CBSE-2019**
28. (a) Give one chemical test as an evidence to show that $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]\text{Cl}$ are ionisation isomers.
 (b) $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic though both are tetrahedral. Why? (Atomic no. of Ni = 28)
 (c) Write the electronic configuration of Fe(III) on the basis of crystal field theory when it forms an octahedral complex in the presence of (i) strong field ligand, and (ii) weak field ligand. (Atomic no. of Fe = 26) **CBSE-2019**
29. Give a brief account of Valence Bond Theory. **Uttarakhand Board-2020**
30. Explain Werner's theory coordination compounds with suitable examples. **Telangana Board-2023**
31. Give the postulates of Werner's theory of coordination compound. **Tamil Nadu Board-2015**
32. Write the application of VB theory on the following complexes:
 (i) $[\text{Fe}^{\text{II}}(\text{F})_6]^{4-}$
 (ii) $[\text{Fe}^{\text{II}}(\text{CN})_6]^{4-}$ **Tamil Nadu Board-2011**
33. Write the postulates of Werner's theory of coordination compounds. **Manipur Board-2017**
34. State any three postulates of Werner theory of co-ordination compounds? **Karnataka Board-2014**
35. a) Mention any two postulates of Werner's theory of co-ordination compounds.
 b) Indicate the type of Isomerism in the following set of complex compounds. **Karnataka Board-2020**
36. (a) Write any two postulates of Werner's theory of co-ordination compounds.
 (b) Write the IUPAC name of $[\text{Pt}(\text{NH}_3)_3(\text{H}_2\text{O})\text{Cl}_2]$ **Karnataka Board-2016**
37. (a) Give any two postulates of Werner's theory.
 (b) Write the structure of trans isomer of $[\text{CO}(\text{NH}_3)_4\text{Cl}_2]^+$. **Karnataka Board-2017**
38. State the oxidation state and coordination number of Cr in $[\text{Cr}(\text{NH}_3)_5\text{Br}]^{2+}$ ion. Using valence bond theory, deduce the structure of $[\text{Ni}(\text{CN})_4]^{2-}$ ion. **Goa Board-2019**
39. Assign the primary valence and secondary valence of the central metal in $[\text{Ni}(\text{CO})_4]$ **Kerala Board-2020**
40. Explain Werner's theory of Co-ordination compounds. **Andhra Pradesh Board-2018**

41. Define primary and secondary valency of metal ion proposed by Werner theory.
Rajasthan Board-2017
42. Write primary and secondary valency of Co in $[\text{CO}(\text{Nn}_3)_6]\text{Cl}_3$.
Rajasthan Board-2017
43. Explain on the basis of valence bond theory that $[\text{Ni}(\text{CN})_4]^{2-}$ is a low spin complex ion.
Rajasthan Board-2015
44. Find the secondary valency of Ni in $[\text{Ni}(\text{CO})_4]$.
Assam Board-2017
45. Explain Werner's theory of co-ordination compounds.
MP Board-2012
46. What are unidentate and bidentate ligands ?
Or
Give an example of linkage isomerism in coordination compounds.
J&K Board-2020
47. Define the terms with examples
(a) Coordination complex
(b) Coordination number
J & K Board-2021
48. Why a solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green while a solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colourless? What is primary valency of Ni in $[\text{Ni}(\text{CO})_4]$?
Assam Board-2023

Section-E : Long Answer

1. Explain Werner's postulates related to the bonding in coordination compounds.
UP Board 2023
2. Mention the type of hybridisation, magnetic property and geometry of the following complexes using VB theory:
(i) $[\text{FeF}_6]^{4-}$
(ii) $[\text{Fe}(\text{CN})_6]^{4-}$
Tamil Nadu Board-2011
3. State the postulates of Werner's theory on co-ordination compound.
Tamil Nadu Board-2011
4. Write the postulates of Valence Bond theory (VB).
Tamil Nadu Board-2016
5. The magnetic behaviour of a complex can be explained on the basis of Valence Bond (VB) theory.
(i) $[\text{Co}(\text{NH}_3)_6]^{3+}$ is a diamagnetic complex and $[\text{CoF}_6]^{3-}$ is a paramagnetic complex. Substantiate the above statement using VB theory.
(ii) Classify the above mentioned complexes into inner orbital and outer orbital complexes.
Kerala Board-2013
6. Consider the co-ordination compound $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
(a) Write the IUPAC name of the above co-ordination compound.

(b) (i) What is the primary valency and secondary valency of the central metal ion in the above co-ordination compound?
(ii) Write the name of isomerism exhibited by the complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$. Represent the possible isomers.

- Kerala Board-2016
7. Give the postulates of Werner's theory of Co-ordination compounds.
Tamilnadu Board, March-2016
8. What is meant by complex compound? Describe the main points of Werner's theory.
Gujarat Board-2018
9. On the basis of valence bond theory state electronic configuration, Hybridization, Magnetic property with calculation of magnetic dipole value and state type of spin present in $[\text{Fe}(\text{CN})_6]^{3-}$ complex.
Gujarat Board-2020
10. Using valence bond theory, show that $[\text{Ni}(\text{CN})_4]^{2-}$ complex ion is diamagnetic in nature. [Atomic number of Ni is 28].
Assam Board-2015

B. Nomenclature of Coordination Compounds

Section-A : Multiple Choice Questions

1. In which complex wavelength of absorbed light is lowest?
(a) $[\text{CO Cl}(\text{NH}_3)_5]^{2+}$ (b) $[\text{CO}(\text{NH}_3)_6]^{3+}$
(c) $[\text{CO}(\text{CN})_6]^{3-}$ (d) $[\text{CO}(\text{NH}_3)_5\text{H}_2\text{O}]^{3+}$
Gujarat Borad-2022 (July)
- Ans. (c)
2. What is the co-ordination number of Cobalt in the $[\text{Co}(\text{NH}_3)_5(\text{CO}_3)]\text{Cl}$ compound?
(a) 4 (b) 6
(c) 8 (d) 5
Haryana Board 2023

- Ans. (b)
3. Which of the following is the IUPAC name of $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$?
(a) Platinum diammine chloronitrite
(b) Chloronitrito-N-ammine platinum-II
(c) Diamminechlorido nitrito-N-Platinum-II
(d) Diammine chloronitrito-N-platinato.
Manipur Board 2020

- Ans. (c)
4. The formula of the complex triamminetri(nitrito-O) Cobalt (III) is
(a) $[\text{Co}(\text{ONO})_3(\text{NH}_3)_3]$
(b) $[\text{Co}(\text{NO}_2)_3(\text{NH}_3)_3]$
(c) $[\text{Co}(\text{ONO}_2)_3(\text{NH}_3)_3]$
(d) $[\text{Co}(\text{NO}_2)(\text{NH}_3)_3]$

CBSE-2020

Ans. (a)

5. The formula of the coordination compound pentaamminenitrito-O-cobalt(III) is:
- $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^+$
 - $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$
 - $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$
 - $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^+$

CBSE-2021

Ans. (c)

6. The coordination number of BN is:
- 3
 - 4
 - 6
 - 8

Tamil Nadu Board-2015

Ans. (a)

7. The coordination number of Pt^{2+} in the complex $[\text{Pt Cl}_2(\text{NH}_3)_2]$ is
- 5
 - 2
 - 6
 - 4

Tamil Nadu Board-2018

Ans. (c)

8. IUPAC name of the complex $\text{K}_3[\text{Fe}(\text{CN})_6]$ is
- potassium hexacyanoferrate
 - potassium hexacyanoferrate (III)
 - potassium hexacyanoiron (II)
 - tripotassium hexacyanoiron (II)

Punjab Board-2021

Ans. (b)

9. The correct formula of a complex having IUPAC name Tetraamminedibromoplatinum (IV) bromide is _____.
- $[\text{PtBr}(\text{NH}_3)_4]\text{Br}_2$
 - $[\text{PtBr}_2(\text{NH}_3)_4]\text{Br}$
 - $[\text{PtBr}_2(\text{NH}_3)_4]\text{Br}_2$
 - $[\text{PtBr}(\text{NH}_3)_4]\text{Br}$

Maharashtra board-2023

Ans. (c)

10. An example of chelating ligand is:
- NO_2^-
 - Chloro
 - Bromo
 - en

Tamilnadu Board, March-2016

Ans. (d)

11. The IUPAC name of $\text{Ni}(\text{CO})_4$ is-
- Tetracarbonyl nickellet (O)
 - Tetracarbonyl nickellet (II)
 - Tetracarbonyl nickel (O)
 - Tetracarbonyl nickel (II)

MP Board-2015

Meghalaya Board-2021

Ans. (c)

12. $\text{K}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$ is named as
- potassium trioxalatoaluminate (III)
 - potassium alumino oxalate
 - potassium aluminium (III) oxalate
 - potassium trioxalatoaluminate (II)

Nagaland Board-2018

Ans. (a)

13. The IUPAC name of $\text{K}[\text{Ag}(\text{CN})_2]$ is
- dicyanosilver (I)
 - dicyanoargentate (I)
 - potassium dicyanoargentate (I)
 - potassium dicyano argentate (II)

Nagaland Board-2017

Ans. (c)

14. Which of the following is not a complex compound?
- Potassium ferrocyanide
 - Potassium ferricyanide
 - Ferrous ammonium sulphate
 - Cuprammonium sulphate

Meghalaya Board-2018

Ans. (c)

Section-B : Very Short Answer

1. (a) Write the IUPAC name and hybridisation of the complex $[\text{Fe}(\text{CN})_6]^{3-}$ (Given : Atomic number of Fe = 26)
 (b) What is the difference between an ambidentate ligand and a chelating ligand?

CBSE-2020

2. What is co-ordination number? What will be the co-ordination number of Pt in $[\text{PtCl}_6]^{2-}$?

Haryana Board 2023

3. Write IUPAC name of $\text{K}_3[\text{Fe}(\text{CN})_6]$ Compound.

Haryana Board 2023

4. Write the IUPAC names of the following compounds:
- $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Br}]\text{Br}_2$
 - $\text{K}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$

Kerala Board 2023

5. Write IUPAC name of $\text{K}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$.

Rajasthan Board 2022

6. Using valence bond theory [VBT], explain geometry, hybridisation and magnetic property of $[\text{CoFe}]^{3-}$ ion.
 [Atomic Number of Cobalt is 27]

Karnataka board 2023

7. Write the IUPAC names of the following coordination compounds-

- $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$
- $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$

Uttarakhand Board 2022

8. (a) Write the IUPAC name and hybridisation of the complex $[\text{CoF}_6]^{3-}$. (Given : Atomic number of Co = 27)
 (b) What type of isomerism is shown by the complex $[\text{Co}(\text{en})_2\text{Cl}_2]^{2+}$? Name the structure of an isomer of this complex which is optically active.

CBSE-2020

9. Give the formulae of the following compounds:
- Potassium trioxalatoaluminate (III)
 - Tetraammineaquachloridocobalt (III)chloride

CBSE-2020

10. Give the formulae of the following compounds:
 (a) Potassium tetrahydroxidozincate (II)
 (b) Hexaammineplatinum (IV) chloride
 CBSE-2020
11. Write the IUPAC name of $[Pt(NH_3)_5 Cl] Cl_3$.
 CBSE-2020
12. (a) Write the IUPAC name of $[Mn(H_2O)_6]SO_4$
 (b) Why is $[Fe(CN)_6]^{4-}$ diamagnetic while $[FeF_6]^{3-}$ is paramagnetic? [At. No. Fe = 26]
 CBSE-2021
13. Using IUPAC norms, write the formulae for the following complexes :
 (c) Tetraamminediaquacobalt(III) chloride
 (d) Dibromidobis(ethane-1,2-diamine) platinum(IV) nitrate
 CBSE-2019
14. Write IUPAC name of the complex $[CO(en)_3(NO_2)Cl]^+$. What type of structural isomerism is shown by this complex?
 CBSE-2019
15. Using IUPAC norms write the formulae for the following complexes :
 (a) Hexaaquachromium (III) Chloride
 (b) Sodium trioxalatoferate (III)
 CBSE-2019
16. Using IUPAC norms write the formulae for the following:
 (a) Potassium tri(oxalate)chromate (III)
 (b) Hexaaquamanganese (II) sulphate
 CBSE-2019
17. Using IUPAC norms write the formulae for the following :
 (a) Hexaamminecobalt(III) sulphate
 (b) Potassium trioxalatochromate(III)
 CBSE-2019
18. Write IUPAC name of the complex $[Pt(en)_2Cl_2]$. Draw structures of geometrical isomers for this complex.
 CBSE-2019
19. Using IUPAC norms write the formulae for the following :
 (a) Hexaamminecobalt(III) sulphate
 (b) Potassium trioxalatochromate(III)
 CBSE-2019
20. (a) Using IUPAC norms write the formula of the following :
 (i) Tetrabromidocuprate (II)
 (ii) Hexaamminecobalt (III) sulphate
 (b) Why does ammonia readily form a complex whereas ammonium does not ?
 CBSE-2019
21. (a) Using IUPAC norms write the formula of the following :
 (i) Pentaamminenitrito-N-cobalt (III) nitrate
 (ii) Triamminechloridonickel (II) nitrate
 (b) Predict the number of unpaired electrons in hexaaquamanganese (II) ion.
 CBSE-2019
22. Write IUPAC name of the complex $K_4[Fe(CN)_6]$.
 CBSE-2019
23. (a) Using IUPAC norms, write the formula of:
 (i) Potassiumtetrachlorido nickelate (II)
 (ii) Hexaammine cobalt (III) sulphate
 (d) Why are tetrahedral complexes always high spin complexes?
 CBSE-2019
24. Write IUPAC name of the complex $[Co(en)_2Cl_2]^+$.
 CBSE-2019
25. Using IUPAC norms, write the formula of Sodium tetrachloronickelate(II).
 CBSE-2019
26. Write IUPAC name of the complex $K_3[Cr(C_2O_4)_3]$
 OR
 Using IUPAC norms write the formula of hexaamminecobalt(III) sulphate.
 CBSE-2019
27. Write IUPAC name of the complex $[Co(en)_2(H_2O)(CN)]^{2+}$.
 CBSE-2019
28. Using IUPAC norms, write the formula of Ammonium tetrafluoridocobaltate(II).
 CBSE-2019
29. Write the IUPAC names of the following coordination compounds:
 (a) $[Cr(NH_3)_4(H_2O)_2]Cl_3$
 (b) $[PtCl_2(NH_3)_4][PtCl_4]$
 ISC Board-2015
30. Write the formula of the following compounds.
 (a) Triaminetriaquachromium (III) chloride
 (b) Potassiumhexacyanoferrate (III)
 ISC Board-2014
31. Give the IUPAC name of the following coordination compounds.
 (a) $K_2[Zn(OH)_4]$
 (b) $[Co(NH_3)_5(CO_3)]Cl$
 ISC Board-2013
32. Write the formula of the following coordination compounds
 (a) Potassiumtetracycyanonickelate (0)
 (b) Triaminetrinitrocobalt (III)
 ISC Board-2012
33. Give the IUPAC name for the following:
 (a) $Na_3[AlF_6]$
 (b) $[Co(NH_3)_6]Cl_3$
 ISC Board-2011
34. Write the formula of the following coordination compound.
 (a) Tetracarbonynickel (0)
 (b) Potassiumdicyanoargentate (I)
 ISC Board-2010
35. Write the formula of the following compounds:
 (a) Potassium trioxalatoaluminate (III)
 (b) Hexaaquairon (II) sulphate.
 ISC Board-2017
36. Write the hybridization, shape and IUPAC name of the complex $[CoF_6]^{3-}$ (Atomic no. of Co = 27).
 Foreign 2014

37. Write the state of hybridization, shape and IUPAC name of the complex $[Co(NH_3)_6]^{3+}$ (Atomic no. of Co = 27). Foreign 2014
38. Name the following coordination compounds according to IUPAC system of nomenclature.
 (i) $[Co(NH_3)_4(H_2O)Cl]Cl_2$
 (ii) $[CrCl_2(en)_2Cl]$
 (where, en = ethane-1, 2-diamine) Delhi 2010
39. Write the IUPAC name of $[CoCl](NO_2)(NH_3)_4Cl$ Delhi 2008C
40. Using IUPAC norms, write the formulae for the following:
 (i) Potassium trioxalatoaluminate (III)
 (ii) Dichloridobis(ethane-1, 2-diamine) cobalt(III) All India 2017
41. Using IUPAC norms write the formulae for the following:
 (i) Sodium dicyanidoaurate (I).
 (ii) Tetraamminechloridonitrito-N-platinum (IV)sulphate. All India 2017
42. (i) Write the IUPAC name of the following complex: $[Co(NH_3)_5Cl]^{2+}$
 (ii) Write the formula for the following complex: Potassium tetrachloridonickelate (II) All India 2015
43. (i) Write down the IUPAC name of the following complex: $[Cr(NH_3)_2Cl_2(en)]Cl$
 (where en = ethylene diamine)
 (ii) Write the formula for the following complex: Pentaamminenitrito-O-cobalt (III) ion Delhi 2015
44. (i) Write down the IUPAC name of the following complex: $[Cr(en)_3]Cl_3$
 (ii) Write the formula for the following complex: Foreign 2015
45. Write the IUPAC name of the complex $[Cr(NH_3)_4Cl_2]^+$. What type of isomerism does it exhibit? Delhi 2017, All India 2014
46. Write the IUPAC name of $[Co(NH_3)_5Cl]Cl_2$ (Atomic no. of Co = 27). Delhi 2010C
47. Name the following coordination compound: $K_3[KrF_6]$ Foreign 2011
48. Write the IUPAC name of $[PtCl(NH_2CH_3)(NH_3)_2Cl]$ Delhi 2011C
49. Write the IUPAC name of $[Pt(NH_3)_4Cl_2]Cl_2$. All India 2011C
50. Write the IUPAC name of $[Cr(NH_3)_6][Co(CN)_6]$. All India 2011C
51. Write the IUPAC name of $[Pt(NH_3)_3(NO)Cl_2]Br_2$. Delhi 2011C
52. Write the IUPAC name of $[Co(CN)_2(NH_3)_4]Cl$. Delhi 2011C
53. Write the IUPAC name of $[Cr(NH_3)_5(NCS)][ZnCl_4]$. All India 2011C
54. Write down the IUPAC name of the complex $[Pt(en)_2Cl_2]^{2+}$. What type of isomerism is shown by this complex. All India 2015
55. What is the IUPAC name of the complex $[Ni(NH_3)_6]Cl_2$? Delhi compartment 2015
56. Write the IUPAC name of the following compound: $[Pt(NO_2)(NH_3)BrCl]$ Assam Board-2022
57. Write down the formula of Tetraamineaquachloridocobalt(III) chloride. Assam Board-2022
58. Using EAN rule predict the molecular formula of nickel carbonyl. Odisha Board-2017
59. The IUPAC name of complex $Na_2[Fe(CN)_5NO]$ is _____. Odisha Board-2020
60. Give the co-ordination isomer of $[Co(NH_3)_6][Cr(CN)_6]$
 Give the IUPAC name of the isomer. Manipur Board-2018
61. Write the I.U.P.A.C. name of $[Fe(CN)_6]^{4-}$. Write its hybridisation and magnetic character. [At.No. : Fe = 26]. NIOS Board-2021
62. Write the IUPAC name of following :
 (a) $K[Ag(CN)_2]$
 (b) $[Cr(NH_3)_3(H_2O)_3]Cl_3$ Punjab Board-2019
63. Write IUPAC name of $Zn_2[Fe(CN)_6]$. Haryana Board-2022
64. Write IUPAC name of $[Pt(NH_3)_4NO_2Cl]SO_4$ Haryana Board-2022
65. is the IUPAC name of the complex compound $K_3[Cr(C_2O_4)_3]$. Haryana Board-2021
66. Write the IUPAC name of $K_2[Zn(OH)_4]$ Kerala Board-2021
67. Write down IUPAC names of the following compounds :
 (i) $[Cr(H_2O)_6]Cl_3$
 (ii) $Na_2[CuCl_4]$
 (iii) $[Pt(CN)_6]^{2-}$ Chhattisgarh Board-2021

- | | | | |
|-----|---|-----|--|
| 68. | For the coordination complex ion $[\text{Co}(\text{NH}_3)_6]^{3+}$
(i) Give the IUPAC name of the complex ion.
ISC Board-2017 | 86. | Using IUPAC norms write the systematic names of the following
(a) $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})_2]\text{Cl}_3$
(b) $[\text{Co}(\text{en})_3]^{3+}$
(c) $[\text{Ni Cl}_4]^{2-}$
Jharkhand Board-2023 |
| 69. | Write the IUPAC name of $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$
Assam Board-2014 | 70. | Write IUPAC names of following:
(i) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
(ii) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
Haryana Board-2017 |
| 71. | Give IUPAC names of the following coordinate compounds:
(i) $[\text{Co}(\text{H}_2\text{O})_3\text{Br Cl NO}_2]$
(ii) $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$
Haryana Board-2016 | 72. | Give any one example of bidentate ligand.
Rajasthan Board-2019 |
| 73. | Write IUPAC name of the following complex compound.
$\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
Rajasthan Board-2018 | 74. | Write the formula of coordination compound mercury tetrathiocyanato-cobaltate (III).
Rajasthan Board-2015 |
| 75. | Write the I.U.P.A.C. names of the following complex compounds:
(a) $\text{K}_3[\text{Ag}(\text{S}_2\text{O}_3)_2]$
(b) $[\text{Fe}(\text{H}_2\text{O})_4(\text{C}_2\text{O}_4)]_2\text{SO}_4$
Rajasthan Board-2011 | 76. | Define the term 'coordination sphere' with one example.
Assam Board-2020 |
| 77. | Write the IUPAC names of $[\text{Co}(\text{NH}_3)_4\text{Cl}(\text{NO}_2)]\text{Cl}$ and $\text{K}_2[\text{NiCl}_4]$.
Assam Board-2019 | 78. | Write the formula of lithium tetrahydridoaluminate (III).
Assam Board-2016 |
| 79. | Write the formula for the co-ordination compound : tetracarbonylnickel(0).
Assam Board-2015 | 80. | Write the IUPAC name of $[\text{PtCl}_2(\text{NH}_3)_2]$
Assam Board-2012 |
| 81. | Write chemical formula of the following coordinate compounds:
(i) Hexaaquachromium (III) chloride
(ii) Potassium tetraiodomercurate (I)
MP Board-2018 | 82. | Name is IUPAC System:
(i) $\text{K}_2[\text{PtCl}_6]$
(ii) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
MP Board-2016 |
| 83. | Write IUPAC name of the following complex compounds:
(i) $[\text{Ni}(\text{CO})_4]$ (b) $\text{K}_2[\text{HgI}_4]$
MP Board-2014 | 84. | What is IUPAC name of $\text{K}_4[\text{Fe}(\text{CN})_6]$?
J & K board-2023 |
| 85. | What is IUPAC name of $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$?
J & K Board-2020 | 86. | Using IUPAC norms write the systematic names of the following
(a) $[\text{Pt}(\text{NH}_3)_6]^{4+}$
(b) $\text{K}_2[\text{Ni}(\text{CN})_4]$
(ii) Define the following :
(a) Complex ion
(b) Co-ordination number.
(c) UP Board 2019 |
| 87. | Write the formulae of the following coordination compounds on the basis of I.U.P.A.C. rules –
(a) Dichloridobis (ethane -1, 2-diamine) cobalt (iii).
(iii) chloride.
(b) Iron (iii) hexacyanidoferate (ii).
UP Board 2023 | 88. | Write IUPAC names of following
(i) $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$
(ii) $[\text{Co}(\text{NH}_3)_6]\text{Br}_3$
(iii) $[\text{Fe}(\text{CN})_6]^{3-}$
Rajasthan Board 2023 |
| 89. | Using IUPAC norms write the systematic names of the following :
(a) $[\text{CO}(\text{NH}_3)_6]\text{Cl}_3$
(b) $[\text{NiCl}_4]^{2-}$
(c) $\text{K}_3[\text{Fe}(\text{CN})_6]$
CBSE-2022 | 90. | (b) (i) Using IUPAC norms write the formulas for the following :
(i.i) Pentaamminenitrito-N-Cobalt (III)
(i.ii) Tetrahydroxidozincate (II)
(ii) What is crystal field splitting energy ?
CBSE-2022 |
| 91. | Write IUPAC names of the following coordination compounds :
(a) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
(b) $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$
(c) $[\text{Co}(\text{SCN})_4]^{2-}$
(d) $[\text{PtCl}_2(\text{NH}_3)_2]$
Telangana Board-2017 | 92. | (i) Write the IUPAC name of the complex $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$.
(ii) What type of isomerism is exhibited by the complex $[\text{Co}(\text{en})_3]^{3+}$?
(iii) Why is $[\text{NiCl}_4]^{2-}$ paramagnetic but $[\text{Ni}(\text{CO})_4]$ is diamagnetic?
(Atomic number of Cr = 24, Co = 27, Ni = 28) |

Section-C : Short Answer

Write the I.U.P.A.C names the following:

- 1.** Write the I.U.P.A.C names the following:

 - $\left[\text{Pt}(\text{NH}_3)_6 \right]^{4+}$
 - $\text{K}_2 \left[\text{Ni}(\text{CN})_4 \right]$

(ii) Define the following :

 - Complex ion
 - Co-ordination number.
 - (c) UP Board 2019

2. Write the formulae of the following coordination compounds on the basis of I.U.P.A.C. rules –

 - Dichloridobis (ethane -1, 2-diamine) cobalt (iii) chloride.
 - Iron (iii) hexacyanidoferate (ii).

UP Board 2023

3. Write IUPAC names of following

 - $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$
 - $[\text{Co}(\text{NH}_3)_6]\text{Br}_3$
 - $[\text{Fe}(\text{CN})_6]^{3-}$

Rajasthan Board 2023

4. Using IUPAC norms write the systematic names of the following :

 - $[\text{CO}(\text{NH}_3)_6]\text{Cl}_3$
 - $[\text{NiCl}_4]^{2-}$
 - $\text{K}_3[\text{Fe}(\text{CN})_6]$

CBSE-2022

5. (b) (i) Using IUPAC norms write the formulas for the following :

 - Pentaamminenitrito-N-Cobalt (III)
 - Tetrahydroxidozincate (II)
 - (ii) What is crystal field splitting energy ?

CBSE-2022

6. Write IUPAC names of the following coordination compounds :

 - $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
 - $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$
 - $[\text{Co}(\text{SCN})_4]^{2-}$
 - $[\text{PtCl}_2(\text{NH}_3)_2]$

Telangana Board-2017

7. (i) Write the IUPAC name of the complex $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$.

(ii) What type of isomerism is exhibited by the complex $[\text{Co}(\text{en})_3]^{3+}$?

(iii) Why is $[\text{NiCl}_4]^{2-}$ paramagnetic but $[\text{Ni}(\text{CO})_4]$ is diamagnetic?
(Atomic number of Cr = 24, Co = 27, Ni = 28)

8. For the complex $[NiCl_4]^{2-}$, write,
 (i) the IUPAC name
 (ii) the hybridization type
 (iii) the shape of the complex (Atomic no, of Ni = 28)
- All India 2013
9. (i) How is double salt different from a complex?
 (ii) Write IUPAC name of the following:
 (a) $K_3[Fe(C_2O_4)_3]$
 (b) $[Pt(NH_3)_6]Cl_4$
 (iii) Draw the structure of cis-isomer of $[Co(NH_3)_4Cl_2]^+$.
- Delhi 2013C
10. Write the IUPAC name of the following coordination compounds:
 (i) $[Cr(NH_3)_3Cl_3]$
 (ii) $K_3[Fe(CN)_6]$
 (iii) $[CoBr_2(en)_2]^+$, (where, en = ethylene diamine)
- Delhi 2013
11. Write the IUPAC name and draw the structure of each of the following complex entities:
- (i) $\left[Co\left(\begin{array}{c} COO \\ | \\ COO \end{array}\right)_3\right]^{3-}$
- (ii) $[Cr(CO)_6]$
- (iii) $[PtCl_3(C_2H_4)]$
- (Atomic no. of Cr = 25, Co = 27, Pt = 78)
- All India 2014
12. Write down the IUPAC name for each of the following complexes:
 (i) $[Co(NH_3)_5Cl]Cl_2$
 (ii) $K_3[Fe(CN)_6]$
 (iii) $[NiCl_4]^{2-}$
- Delhi 2014C
13. Write the IUPAC name of the following:
 (i) $[Co(NH_3)_6]Cl_3$
 (ii) $[NiCl_4]^{2-}$
 (iii) $K_3[Fe(CN)_6]$
- All India 2015
14. Write down the IUPAC name of the following complexes and calculate their magnetic moment.
 (i) $K_3[Co(C_2O_4)_3]$
 (ii) $Cs[FeCl_4]$
- Gujarat Board-2021
15. Write the structural formulae of the following compounds :
 (i) Dichlorobis (ethylenediamine) cobalt (IV) sulphate
 (ii) Tetramine chloronitrocobalt (III) nitrate
 (iii) Tetraaquodichlorochromium (III) nitrate
- Chhattisgarh Board-2023
16. (a) Write the formula of the following coordination compound : Iron(III) hexacyanoferrate(II)
- (b) What type of isomerism is exhibited by the complex $[Co(NH_3)_5Cl]SO_4$?
 (c) Write the hybridisation and number of unpaired electrons in the complex $[CoF_6]^{3-}$. (Atomic No. of Co = 27)
- UP Board-2018
17. Give the IUPAC name of $[Ti(H_2O_6)]^{3+}$. Draw cis and trans isomers of $[Pt(NH_3)_2Cl_2]$.
- Karnataka Board-2014
- 18.(a) Write the names of the following complexes:
 (i) $[Fe(NH_3)_4Cl_2]Cl$
 (ii) $[Pt(NH_3)_2Cl_2]$
 (b). Explain the following terms, giving a suitable example in each case :
 (i) Ligand
 (ii) Coordination sphere
- NIOS Board-2016
19. (a) Write the state of hybridization, shape and IUPAC name of the complex $[COF_6]^{3-}$ [Atomic number of Co = 27]
 (b) Complete the following equations
 (i) $Cr_2O_7^{2-} + 2OH^- \longrightarrow$
 (ii) $MnO_4^- + 8H^+ + 5Fe^{2+} \longrightarrow$
- NIOS Board-2015
20. Using IUPAC norms, write the systematic names of the following :
 (a) $[Co(NH_3)_6]Cl_3$ (b) $[Fe(C_2O_4)_3]^{-3}$
 (c) $[Fe(CN)_6]^{4-}$ (d) $[NiCl_4]^{2-}$
- Andhra Pradesh Board-2019
21. Using IUPAC norms, write the formulae for the following :
 (a) hexa-amine cobalt (III) sulphate
 (b) tetra-aquadichlorido-chromium (III) ion
 (c) potassium dicyanoargentate (I).
- Jharkhand Board-2018
22. a) What is the IUPAC name of $[Cr(NH_3)_3(H_2O)_3]Cl_3$?
 b) Give the facial (fac) and Meridional (mer) isomeric structure of $[CO(NH_3)_3(NO_2)_3]$
- Karnataka Board-2015
23. a) For a given complex $[CO(NH_3)_5NO_2]Cl_2$. Write its IUPAC and Linkage isomer.
 b) Which set of d-orbital's of a metal atom/ion experience more repulsion in octahedral field created by the ligands?
- Karnataka Board-2019
24. Write the IUPAC names of the following compounds :
 (a) $K_4[Fe(CN)_6]$
 (b) $[Co(NH_3)_4Cl_2]NO_3$
 (c) $[Zn(NH_3)_4]^{2+}$
- Chhattisgarh Board-2022
25. Using IUPAC norms write formula for the following :
 (a) Potassium tri(oxalato) chromate (III)
 (b) Tetrabromido cuprate (II)
 (c) Hexammine nickel (II) chloride.
- Jharkhand Board-2019

50. (a) Write down the name of $[\text{Cr}(\text{NH}_3)_2 \text{Cl}_4]^-$ complex on the basis of IUPAC.
(b) What is the oxidation state and coordination number of chromium in the above complex?
(c) Name the type of isomerism in the following pair of complexes:
 $[\text{CO}(\text{NH}_3)_5 \text{SCN}]^+$ and $[\text{Co}(\text{NH}_3)_5\text{NCS}]^+$
(d) Find out the type of hybridization and magnetic behaviour of $[\text{NiCl}_4]^{2-}$

NIOS Board-2018

51. For the complex $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$ mention:
(i) IUPAC name.
(ii) Central metal ion
(iii) Ligands
(iv) Co-ordination number
(v) Shape

Tamil Nadu Board-2016

52. For the given complex $[\text{Ni}(\text{PPh}_3)_2\text{Cl}_2]$ Mention.
(i) IUPAC Name
(ii) Central metal ion
(iii) Ligands
(iv) Coordination number
(v) Nature of the complex

Tamil Nadu Board-2018

53. (a) Write the name of $\text{K}[(\text{NH}_3)_2(\text{NO}_3)_4]$ complex.
(b) Name the type of isomerism present in $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ and $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2\cdot\text{H}_2\text{O}$.
(c) What are interhalogen compounds? Give two examples.

NIOS Board-2016

- 54.(a) Write the IUPAC name of the following complex :
 $\text{Pt}[\text{Cl}_2(\text{en})_2](\text{NO}_3)_2$
(b) Name the type of isomerism exhibited by the following pairs of complexes :
(i) $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ and $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
(ii) $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ and $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$

Meghalaya Board-2019

55. Is the complex $[\text{Ni}(\text{CO})_4]$ a low-spin or a high-spin complex? Explain on the basis of VBT.
Meghalaya Board-2019

C. General Properties of Coordination compound

Section-A : Multiple Choice Questions

1. Which is correct formula of Wilkinson catalyst?
(a) $[(\text{Me}_3\text{As})_3 \text{RhCl}]$ (b) $[(\text{Me}_3\text{P})_3 \text{RhCl}]$
(c) $[(\text{Ph}_3\text{P}) \text{RhCl}]$ (d) $[(\text{Ph}_3\text{As})_3 \text{RhCl}]$

Gujarat Board 2023 (March)

Ans. (c)

2. Which compound has magnetic moment equal to 4.90 BM?
(a) $\text{Cr}_2(\text{SO}_4)_3$ (b) NiSO_4
(c) FeSO_4 (d) MnSO_4

Gujarat Board 2023 (March)

Ans. (c)

3. From the following which ion has lowest magnetic moment?
(a) Ti^{3+} (b) Co^{3+}
(c) Cr^{3+} (d) Fe^{3+}

Gujarat Board-2022 (July)

Ans. (b)

4. Oxidation state of Iron in $\text{K}_4[\text{Fe}(\text{CN})_6]$ is –
(a) 3 (b) 2
(c) 8 (d) 5

MP Board 2020

Ans. (b)

5. The colour of which of the following compounds is NOT due to d-d transition
(a) CoCl_2
(b) KMnO_4
(c) $\text{Cr}_2(\text{SO}_4)_3$
(d) NiSO_4

Manipur Board 2020

Ans. (b)

6. The co-ordination compound having tetrahedral geometry is –
(a) $[\text{Ni}(\text{CN})_4]^{2-}$ (b) $[\text{Ni}(\text{CO})_4]$
(c) $[\text{Fe}(\text{CO})_5]$ (d) $[\text{Cr}(\text{CO})_6]$

Rajasthan Board 2022

Ans. (a)

7. Didentate Ligand is –
(a) $\text{C}_2\text{O}_4^{2-}$ (b) SCN^-
(c) NH_3 (d) Cl^-

Rajasthan Board 2023

Ans. (a)

8. Assertion (A) : Low spin tetrahedral complexes are rarely observed.
Reason (R) : Crystal field splitting energy is less than pairing energy for tetrahedral complexes.
(a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is correct, but Reason (R) is wrong statement.
(d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

Ans. (a)

21. $[\text{Fe}(\text{CN})_6]^{4-}$ and $[\text{Fe}(\text{CN})_6]^{3-}$ are of different colours in dilute solutions. Why ? CBSE-2019
22. Write the hybridization and magnetic character of the following complexes :
 (i) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
 (ii) $[\text{Ni}(\text{CN})_4]^{2-}$
 [Atomic number : Fe = 26. Ni = 28] CBSE-2019
23. In the complexes $[\text{Fe}(\text{CN})_6]^{3-}$ and $[\text{Pt}(\text{en})(\text{H}_2\text{O})_2(\text{NO}_2)(\text{Cl})]^{2+}$ the respective oxidation numbers of central metal atoms are
 (a) +3 and +4 (b) +6 and +4
 (c) +6 and +3 (d) +3 and +3 ISC Board-2015
24. State the hybridisation and magnetic property of $[\text{Fe}(\text{CN})_6]^{3-}$ ion according to the valence bond theory. ISC Board-2015
25. For the complex ion of $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (i) state the hybridisation of the complex
 (ii) state the magnetic nature of the complex ISC Board-2014
26. For the complex ion $[\text{Fe}(\text{CN})_6]^{3-}$, state
 (i) the geometry of the ion.
 (ii) the magnetic property of the ion ISC Board-2013
27. Draw the structural isomer of $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$ and name the type of isomerism. ISC Board-2012
28. Correct the following statement by changing the underlined part of sentence.
 In a coordination complex, donation of electron pair takes place from the central metal atom to the ligands. ISC Board-2009
29. Give the name, the stereochemistry and the magnetic behaviour of the following complexes.
 (i) $[\text{Co}(\text{NH}_3)_5\text{Cl}] \text{Cl}_2$
 (ii) $\text{K}_2[\text{Ni}(\text{CN})_4]$ Foreign 2011
30. State reason for each of the following
 (i) CO is stronger complexing reagent than NH₃.
 (ii) The molecular shape of Ni(CO)₄ is not the same as that of $[\text{Ni}(\text{CN})_4]^{2-}$. Delhi 2012
31. Explain the following observations:
 (i) Co²⁺ is easily oxidized to Co³⁺ in the presence of a strong ligand.
 (ii) CO is a stronger complexing reagent than NH₃. Delhi 2012C
32. What is meant by crystal field splitting energy? How does the magnitude of splitting decide the actual configuration of d-orbitals in an octahedral field for a coordination entity? Delhi 2011C
33. What do you understand by stepwise stability constant and overall stability constant of a coordination compound? How are these two constants related? All India 2011C
34. Describe the shape and magnetic behaviour of the following complex.
 $[\text{Ni}(\text{CN})_4]^{3-}$ Delhi 2010
35. Using the valence bond theory predict the geometry and magnetic behaviour of $[\text{CoF}_6]^{3-}$. (Atomic number of Co = 27) Delhi 2010C
36. Describe the state of hybridization, shape and the magnetic behaviour of the following complexes.
 (i) $[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]^-$
 (ii) $[\text{Co}(\text{NH}_3)_2(\text{en})_2]^{3+}$
 (Atomic no. of Cr = 24, Co = 27) Foreign 2010
37. Explain the following terms:
 (i) Crystal field splitting in an octahedral field.
 (ii) Spectrochemical series. Foreign 2010
38. Using valence bond approach, deduce the shape and magnetic character of $[\text{Co}(\text{NH}_3)_6]^{3+}$ ion. (Atomic no. of Co = 27) All India 2010
39. Write the hybridization and shape of the following complexes.
 (i) $[\text{CoF}_6]^{3-}$ (ii) $[\text{Ni}(\text{CN})_4]^{2-}$ All India 2014C
40. Why is CO a stronger ligand than Cl⁻? Foreign 2011
41. What is meant by chelate effect? All India 2015
42. Name the following coordination compounds and draw their structures.
 (i) $[\text{CoCl}_2(\text{en})_2]\text{Cl}$
 (ii) $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$
 (Atomic no. of Co = 27, Pt = 78) Foreign 2011
43. What is ambidentate ligand? Give an example. Foreign 2010
44. $[\text{NiCl}_4]^{2-}$ is paramagnetic, while $[\text{Ni}(\text{CO})_4]$ is diamagnetic, why? Uttarakhand Board-2020
45. What is a ligand? Give one example for unidentate ligand. Telangana Board-2023
46. Write the coordination number and oxidation state of Platinum in the complex $[\text{Pt}(\text{en})_2\text{Cl}_2]$. UP Board-2018
47. Transition ions and their compounds are coloured. Explain. Odisha Board-2023
48. What is an ambidentate ligand. Karnataka Board-2018

Section-C : Short Answer

68. (i) Draw the structure of the geometrical isomers of the co-ordination compound $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$.
(ii) On the basis of Valence Bond Theory (VBT) explain the structure and magnetic property of $[\text{Ni}(\text{CN})_4]^{2-}$

Kerala Board 2023

69. (a) What are heteroleptic complexes? Give an example.
(b) If $\Delta_0 < P$, on the basis of Crystal Field Theory [CFT], write the electronic configuration of d^4 -ion in octahedral complexes.

Karnataka board 2023

70. Calculate the 'Spin only' magnetic moment of $\text{Cu}_{(\text{aq})}^{2+}$ ion.

Rajasthan Board 2023

71. Write the hybridisation and magnetic characters of the following complexes:
(i) $[\text{Fe}(\text{CN})_6]^{4-}$
(ii) $[(\text{CoF}_6)]^{3-}$
(iii) $[\text{Ni}(\text{CO})_4]$
[Atomic number : = Fe = 26, Co = 27, Ni = 28]

CBSE-2020

72. (a) Write the hybridization and magnetic behaviour of the following complex:
(a) $[\text{CoF}_6]^{3-}$
(b) $[\text{Ni}(\text{CN})_4]^{2-}$
[Atomic number of Co = 27, Ni = 28]

CBSE-2021

73. (a) Write the hybridization and magnetic character of the following complexes on the basis of valence bond theory:
(i) $[\text{FeF}_6]^{3-}$
(ii) $[\text{Co}(\text{ox})_3]^{3-}$
[Atomic number: Fe = 26, Co = 27]
(b) Write the formula of the following complex:
Hexaamminecobalt (III) chloride

CBSE-2022

74. (i) Define the following terms with an example :
(I) Ambidentate ligand
(II) Chelate effect
(ii) Write the formula of the following complex. hexaammineplatinum (II) chloride

CBSE-2022

75. (a) Using valence bond theory, predict the hybridization and magnetic character of following:
 $[\text{CoF}_6]^{3-}$ [Atomic number of Co = 27]
(b) Write IUPAC name of the following complex :
 $[\text{CoBr}_2(\text{en})_2]^+$
(c) How many ions are produced from the complex $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$ in solution?

CBSE-2022

76. (a) Write the hybridisation and magnetic character of the following complexes :

- (i) $[\text{NiCl}_4]^{2-}$
(ii) $[\text{Co}(\text{NH}_3)_6]^{3+}$
(iii) $[\text{FeF}_6]^{3-}$
[Atomic number : Ni = 28, Co = 27, Fe = 26]
- CBSE-2022
77. (b) (i) Write the IUPAC name of the following complex:
 $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]^{\text{Cl}_2}$
(ii) What is the difference between an Ambidentate ligand and a Bidentate ligand ?
(iii) Out of $[\text{Fe}(\text{NH}_3)_6]^{3+}$ and $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$, which complex is more stable and why ?
- CBSE-2022
78. (a) (i) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_0 < P$.
(ii) Using valence bond theory, predict the hybridization and magnetic character of $[\text{Ni}(\text{CN})_4]^{2-}$.
(Atomic number of Ni = 28)
(iii) Write the formula of the following complex using IUPAC norms :
Dichloridobis (ethane-1,2-diamine) cobalt (III)
- CBSE-2022
79. (a) (i) Write the IUPAC name of the following complex : $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$
(b) On the basis of crystal field theory, write the electronic configuration of d^5 ion if $\Delta_0 < P$.
(c) What are ambidentate ligands ?
- CBSE-2022
80. Give reasons for the following statements :
(a) Scandium ($Z = 21$) is a transition element but Zn ($Z = 30$) is not.
(b) $[\text{Ti}(\text{H}_2\text{O})]^{3+}$ is coloured while $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ is colourless.
(c) Physical and chemical properties of the 4d and 5d series of the transition elements are quite similar than expected.
- CBSE-2022
81. (a) (i) Write the IUPAC name of the following complex : $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$
(ii) On the basis of crystal field theory, write the electronic configuration of d^4 ion, if $\Delta_0 < P$.
(iii) What are Heteroleptic complexes ?
- CBSE-2022
82. (a) Although both $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CO})_4]$ have sp^3 hybridisation yet $[\text{NiCl}_4]^{2-}$ is paramagnetic and $[\text{Ni}(\text{CO})_4]$ is diamagnetic. Give reason. (Atomic no. of Ni = 28)
(b) Write the electronic configuration of d^5 on the basis of crystal field theory when
(i) $\Delta_0 < P$ and
(ii) $\Delta_0 > P$
- CBSE-2019
83. (a) Draw the structures of geometrical isomers of $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^-$
(b) $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic though both are tetrahedral. Why? [Atomic number of Ni = 28]
- CBSE-2019
84. Define the following:
(a) Ambidentate ligands
(b) Spectro chemical series
(c) Heteroleptic complexes
- CBSE-2019
85. Give reasons for the following :
(i) The transition metals generally form coloured compounds.
(ii) E° value for $(\text{Mn}^{3+}|\text{Mn}^{2+})$ is highly positive than that for $(\text{Cr}^{3+}|\text{Cr}^{2+})$ couple.
(iii) The chemistry of actinoids elements is not so smooth as that of the lanthanoids.
- CBSE-2019
86. (a) Draw the structures of geometrical isomers of $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^-$
(b) $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic though both are tetrahedral. Why? [Atomic number of Ni = 28]
- CBSE-2019
87. Define the following:
(a) Ambidentate ligands
(b) Spectro chemical series
(c) Heteroleptic complexes
- CBSE-2019
88. (a) Account for the following :
(i) Manganese shows maximum number of oxidation states in 3d series.
(ii) E° value for $(\text{Mn}^{3+}|\text{Mn}^{2+})$ couple is much more positive than that for $(\text{Cr}^{3+}|\text{Cr}^{2+})$.
(iii) Ti^{4+} is colourless whereas V^{4+} is coloured in an aqueous solution.
(b) Write the chemical equations for the preparation of KMnO_4 from MnO_2 . Why does purple colour of acidified permanganate solution decolourise when it oxidises Fe^{2+} to Fe^{3+} ?
- CBSE-2019
89. (i) Using valence bond theory, explain the geometry and magnetic behaviour of $[\text{Cr}(\text{NH}_3)_6]^{3+}$. (Atomic no. of Cr = 24).
(ii) Write the IUPAC name of ionization isomer of $[\text{Ni}(\text{NH}_3)_3 \text{NO}_3]\text{Cl}$.
- Delhi 2013C
90. Write the name, structure and the magnetic behaviour of each one of the following complexes:
(i) $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$
(ii) $[\text{Co}(\text{NH}_3)_4 \text{Cl}_2]\text{Cl}$
(iii) $\text{Ni}(\text{CO})_4$ (Atomic no. of Co = 27, Ni = 28, Pt = 78)
- Delhi 2012
91. Name the following coordination entities and describe their structures:
(Atomic no. of Fe = 26, Cr = 24, Ni = 28)
(i) $[\text{Fe}(\text{CN})_6]^{4-}$
(ii) $[\text{Cr}(\text{NH}_3)_4 \text{Cl}_2]^+$
(iii) $[\text{Ni}(\text{CN})_4]^{2-}$
- All India 2012

116. Give the oxidation state and coordination number of the central metal ion in the following complexes.
- (a) $[\text{CO}(\text{en})_3]^{3+}$ (b) $\text{K}_4[\text{Fe}(\text{CN})_6]$
- Rajasthan Board-2019
117. Explain the difference between a double-salt and a complex, giving an example in each case.
- Rajasthan Board-2014
118. Write the IUPAC name of $[\text{Ag}(\text{NH}_3)_2][\text{Ag}(\text{CN})_2]$ coordination compound.
- Rajasthan Board-2014
119. What is ligand? Explain classification of ligand with illustration.
- Gujarat Board-2017
120. Give reasons:
- (i) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is coloured while $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ is colourless.
- (ii) $[\text{CoF}_6]^{3-}$ is a high spin complex ion.
- (b) Draw the two geometrical isomers of the complex compound $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$.
- Assam Board-2013
121. What is effective atomic number Explain with examples.
- MP Board-2017
122. What are chelates? Giving one example write the importance of chelate.
- MP Board-2013
123. Define Co-ordination Number.
Or
Explain Ionization isomerism.
- J & K board-2023
- Section-D : Case Based Study**
- $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ contains five unpaired electrons while $[\text{Mn}(\text{CN})_6]^{4-}$ contains only one unpaired electron. Explain using crystal field theory
- Gujarat Board 2023 (March)
- Explain on the basis of valence bond theory that $[\text{Ni}(\text{CN})_4]^{2-}$ ion with square planar structure is diamagnetic and the $[\text{NiCl}_4]^{2-}$ ion with tetrahedral geometry is paramagnetic.
- Gujarat Board-2022 (July)
- Out of $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{en})_3]^{3+}$, which one complex is
 - paramagnetic
 - more stable
 - inner orbital complex and
 - high spin complex

(Atomic no. of Co = 27)
- CBSE-2019
- Section-E : Long Answer**
- (b) (i) Calculate the spin only magnetic moment of the complex $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$. (Atomic number of Fe = 26)
 (ii) Which out of the following two complexes is more stable and why ?
 $[\text{CoF}_6]^{3-}$, $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$
- (iii) Write the IUPAC name of the given complex : $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- CBSE-2022
- (i) What is a ligand? Give an example of a bidentate ligand.
 - Explain as to how the two complexes of nickel, $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Ni}(\text{CO})_4]$ have different structure but do not differ in their magnetic behaviour. (Atomic no. of Ni = 28)
- Delhi 2008
- Giving a suitable example for each explain the following:
 - Crystal field splitting.
 - Linkage isomerism.
 - Ambidentate ligand.
- All India 2009
- Square planar complexes of MX_2L_2 type with coordination number of 4 exhibit geometrical isomerism whereas tetrahedral complexes with similar composition do not. Why?
 - Describe the type of hybridization, shape and magnetic property of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$. (Atomic no. of Co = 27)
- Delhi 2009C
- For the complex $[\text{Fe}(\text{en})_2\text{Cl}_2]\text{Cl}$, identify the following:
 - Oxidation number of iron.
 - Hybrid orbitals and shape of the complex.
 - Magnetic behaviour of the complex.
 - Number of its geometrical isomers.
 - Whether there may be optical isomer also.
 - Name of the complex.
- Delhi 2011, 2009 HOTS
- Explain the following terms giving a suitable example in each case.
 - Ambidentate ligand.
 - Denticity of ligand.
 - Crystal field splitting in an octahedral field.
- All India 2011
- Write the name, state of hybridization, shape and magnetic behaviour of the following complexes:
 $[\text{CoCl}_4]^{2-}$, $[\text{Ni}(\text{CN})_4]^{2-}$, $[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]^-$
 (Atomic no. of Co = 27, Ni = 28, Cr = 24)
- All India 2010
- Give the formula of each of the following coordination entities:
 - Co^{3+} ion is bound to one Cl^- , one NH_3 and two bidentate ethylene diamine (en) molecules.
 - Ni^{2+} ion is bound to two water molecules and two oxalate ions. Write the name and magnetic behaviour of each of the above coordination entities.
 (Atomic no. of Co = 27, Ni = 28)
- Foreign 2012

9. Explain the following cases giving appropriate reason:
 (i) Nickel does not form low spin octahedral complexes.
 (ii) The \square -complexes are known for the transition metals only.
 (iii) Co^{2+} is easily oxidized to Co^{3+} in the presence of a strong ligand.
- All India 2010
10. Compare the following complexes with respect to their shape, magnetic behaviour and the hybrid orbitals involved
 (i) $[\text{COF}_4]^{2-}$ (ii) $[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]^-$
 (iii) $[\text{Ni}(\text{CO})_4]$ (Atomic no. of Co = 27, Cr = 24 and Ni = 28)
- Delhi 2009
11. Compare the following complexes with respect to structural shapes of units, magnetic behaviour and hybrid orbitals involved in units. $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Cr}(\text{NH}_3)_6]^{3+}$, $\text{Ni}(\text{CO})_4$ (Atomic no. of Co = 27, Cr = 24, Ni = 28)
- All India 2009
12. Explain the following:
 (i) Low spin octahedral complexes of nickel are not known.
 (ii) The \square -complexes are known for transition elements only.
 (iii) CO is a stronger ligand than NH_3 for many metals.
- All India 2009
13. Compare the following complexes with respect to structural shapes of units, magnetic behaviour and hybrid orbitals involved in units
 (i) $[\text{Ni}(\text{CN})_4]^{2-}$ (ii) $[\text{NiCl}_4]^{2-}$
 (iii) $[\text{CoF}_6]^-$ (Atomic no. of Ni = 28, Co = 27)
- All India 2009
14. Describe with an example of each, the role of coordination compounds in
 (i) biological system
 (ii) analytical chemistry
 (iii) medicinal chemistry
- All India 2009C
15. Compare the following complexes with respect to their molecular shape and magnetic behaviour.
 (i) $[\text{Cr}(\text{NH}_3)_6]^{3+}$ (ii) $[\text{Fe}(\text{CN})_6]^{4-}$
 (iii) $[\text{NiCl}_4]^{2-}$ (Atomic no. of Cr = 24, Fe = 26 and Ni = 28)
- Foreign 2009
16. Write the hybridization state of central atom of the following co-ordination complexes along with their magnetic properties.
 $[\text{Cu}(\text{NH}_3)_4]^{2+}$ and $[\text{Ni}(\text{CO})_4]$
- Assam Board-2022
17. What is a ligand ? Why is the interaction between the metal ion and the ligand considered as Lewis acid-base reaction ? Identify.
 (i) the entities present in its coordination sphere of the complex $[\text{Co}(\text{en})_2\text{Cl}_2\text{Cl}]$,
 (ii) the types of ligands present and
 (iii) the chelating agent present in it
- NIOS Board-2022
18. Compare the following complexes with respect to their shape, magnetic behaviour, hybrid orbitals involved and coordination number:
 (i) $[\text{CoF}_4]^{2-}$
 (ii) $[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]^-$
 (iii) $[\text{Ni}(\text{CO})_4]$
 [Atomic number : Cr = 24, Co = 27, Ni = 28]
- NIOS Board-2023
19. (i) Find out the bond order of O_2 molecule on the basis of MOT and also predict its magnetic behaviour.
 (ii) NH_3 , H_2O and CH_4 are sp^3 hybridized, but they differ in shapes and bond angles. Why?
 (iii) B-F bonds are polar but BF_3 molecule does not show dipole moment. Why?
- NIOS Board-2023
20. What is meant by Ligands? Describe its classification.
- Gujarat Board-2019
21. Define chelate with example. Write the importance of chelate.
- Haryana Board-2017

D. Bonding in Coordination Compounds

Section-A : Multiple Choice Questions

1. Which is electronic structure of d-orbital's in complex $(\text{NH}_4)_2[\text{CoF}_4]$.
 (a) $\text{eg}^4 \text{t}_{2g}^2$ (b) $\text{t}_{2g}^6 \text{eg}^1$
 (c) $\text{eg}^4 \text{t}_{2g}^3$ (d) $\text{eg}^2 \text{t}_{2g}^5$
- Gujarat Board-2018

Ans. (c)

Section-B : Very Short Answer

1. (i) What is Spectrochemical series?
 (ii) Draw figure to show the splitting of d orbitals in octahedral crystal field and label the diagram.
- Kerala Board 2023
2. What is meant by unidentate and ambidentate ligands? Give two examples for each.
- Punjab Board-2021

Section-C : Short Answer

1. a) Draw energy level diagram for the splitting of d-orbital's in an octahedral crystal field.
 b) How many Cl^- ions can be precipitated as AgCl by adding excess of aqueous AgNO_3 solution into one mole of $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$?
- Karnataka Board-2020
1. Give the oxidation number and coordination number of the central metal atom in the complex compound $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$.
- Rajasthan Board-2013

2. Specify the oxidation numbers of the metals in the following coordination entities:
- $[\text{Co}(\text{H}_2\text{O})(\text{CN})(\text{en})_2]^{2+}$
 - $[\text{CoBr}_2(\text{en})_2]^+$
 - $[\text{PtCl}_4]^{2-}$
 - $\text{K}_3[\text{Fe}(\text{CN})_6]$

Assam Board-2019

Section-E : Long Answer

1. Discuss the nature of bonding in $\text{K}_4[\text{Fe}(\text{CN})_6]$ on the basis of valence bond theory.

Gujarat Board-2021

2. Explain Werner's theory of co-ordination compounds with suitable examples.

Andhra Pradesh Board-2020

E. Bonding in Metal Carbonyl

Section-A : Multiple Choice Questions

1. Which transition of electron will be observed in the following, when Ti^{3+} ion having complex absorbs visible light of certain wavelength?

- (a) $t_{2g}^1 e_g^1 \quad t_{2g}^0 e_g^2$ (b) $t_{2g}^2 e_g^0 \quad t_{2g}^1 e_g^1$
 (c) $t_{2g}^0 e_g^1 \quad t_{2g}^1 e_g^0$ (d) $t_{2g}^1 e_g^0 \quad t_{2g}^0 e_g^1$

Gujarat Board-2019

Ans. (c)

2. Which is present in Metal carbonyls?

- (a) M – C σ bond
 (b) M – C π bond
 (c) M – C σ and M – C π bond
 (d) None of these

Haryana Board-2016

Ans. (c)

3. In metal carbonyls the ligand is ____.

- (a) carbon dioxide
 (b) carbon monoxide
 (c) carbonate
 (d) aldehydes and ketones

Manipur Board-2022

Ans. (b)

4. Which of the following complex has sp $_3$ hybridization?

- (a) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (b) $[\text{Ni}(\text{NH}_3)_2\text{Cl}_2]$
 (c) $\text{K}_2[\text{Ni}(\text{CN})_4]$ (d) $\text{K}_4[\text{Ni}(\text{CN})_4]$

Gujarat Board-2018

Ans.(d) :

5. Which of the following is a most stable complex compound?

- (a) $[\text{Fe}(\text{H}_2\text{O})_4]^{3+}$ (b) $[\text{Fe}(\text{C}_2\text{O}_4)]^{3-}$
 (c) $[\text{Fe}(\text{NH}_3)_6]^{3+}$ (d) $[\text{FeCl}_4]^{3-}$

Gujarat Board-2020

Ans : (b)

6. Which of the following complex does not form coloured solution?

- (a) $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ (b) $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$
 (c) $[\text{Ti}(\text{H}_3\text{O})_6]^{3+}$ (d) $[\text{Ni}(\text{CO})_4]$

Gujarat Board-2020

Ans. (d)

Section-B : Very Short Answer

1. Explain the nature of bonding in metal carbonyls.

Gujarat Board 2023 (March)

2. Draw the synergic bonding present in carbonyl complex.

Rajasthan Board 2022

3. $[\text{NiCl}_4]^{2-}$ is paramagnetic, while $[\text{Ni}(\text{CO})_4]$ is diamagnetic, though both are tetrahedral. Why?

Uttarakhand Board 2023

4. Discuss the nature of bonding in metal carbonyls.

CBSE-2020

5. Explain the violet colour of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex on basis of the crystal field theory?

Rajasthan Board-2016

6. What are the ambidentate ligands? Given on suitable example of ambidentate ligand.

Assam Board-2016

Section-C : Short Answer

1. On the basis of valence bond theory explain the oxidation state, hybridization, geometry and magnetic nature of metal in complex $[\text{CoF}_6]^{3-}$.

Rajasthan Board-2018

Section-E : Long Answer

1. (i) With the help of a diagram, give the splitting of d-orbital's of Mn^{2+} ion in an octahedral crystal field.

- (ii) On the basis of crystal field theory, explain why $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ contains five unpaired electrons while $[\text{Mn}(\text{CN})_6]^{4-}$ contains only one unpaired electron.

Kerala Board-2019

2. Draw the structure which shows synergic bonding interaction in a carbonyl complex.

Rajasthan Board-2017

F. Isomerism in Coordination Compound

Section-A : Multiple Choice Questions

1. The compounds $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$, $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2$, H_2O and $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$, $2\text{H}_2\text{O}$ exhibit:

- (a) Linkage isomerism
 (b) Geometrical isomerism
 (c) Ionization isomerism
 (d) Hydrate isomerism

Gujarat Board 2023 (July)

Ans. (d)

2. Which type of isomerism is possessed by complexes $[\text{CO}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ and $[\text{CO}(\text{NH}_3)_5\text{Br}]\text{SO}_4$?

- (a) Optical (b) Geometric
 (c) Ionisation (d) Coordination

Gujarat Borad-2022 (July)

Ans. (c)

3. What type of isomerism is shown by the pair $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ and $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$?
 (a) Ionization isomerism
 (b) Coordination isomerism
 (c) Solvate isomerism
 (d) Linkage isomerism

CBSE-2020

Ans. (a)

4. The pair $[\text{Co}(\text{NH}_3)_4 \text{Cl}_2] \text{Br}_2$ and $[\text{Co}(\text{NH}_3)_4 \text{Br}_2] \text{Cl}_2$ will show
 (a) Linkage isomerism
 (b) Hydrate isomerism
 (c) Ionization isomerism
 (d) Coordinate isomerism

CBSE-2020

Ans. (c)

5. Indicate the complex ion which shows geometrical isomerism.
 (a) $[\text{Cr}(\text{H}_2\text{O})_4 \text{Cl}_2]^+$ (b) $[\text{Pt}(\text{NH}_3)_3 \text{Cl}]^+$
 (c) $[\text{Co}(\text{NH}_3)_6]^{3+}$ (d) $[\text{Co}(\text{CN})_5 (\text{NC})]^{3-}$

CBSE-2020

Ans. (a)

6. Which of the following compounds does not show optical activity?
 (a) Cis $[\text{CrCl}_2(\text{OX})_2]^3$
 (b) Cis $[\text{CoBr}_2(\text{en})_2]$
 (c) Cis $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]$
 (d) Cis- $[\text{PtCl}_2(\text{en})_2]^{2+}$

Gujarat Board-2021

Ans. (a)

7. Complexes $[\text{Co}(\text{NH}_3)_5 \text{SO}_4] \text{Br}$ and $[\text{Co}(\text{NH}_3)_5 \text{Br}] \text{SO}_4$ are example ofisomerism.
 (a) Ionisation (b) Linkage
 (c) Coordination (d) Solvate

Gujarat Board-2021

Ans. (a)

8. Which kinds of isomerism are exhibited by octahedral $\text{Co}(\text{NH}_3)_4 \text{Br}_2\text{Cl}_2$?
 (a) Geometrical and ionization
 (b) Geometrical and optical
 (c) Optical and ionization
 (d) Geometrical only

Odisha Board-2017

Ans. (a)

9. Which one of the following complex ion possess ionization isomerism?
 (a) $[\text{Pt}(\text{NH}_3)_4 \text{Cl}_2] \text{Br}_2$ (b) $[\text{Pt}(\text{Cl}_2 \cdot (\text{en}))_2]^2$
 (c) $[\text{Cr}(\text{C}_2\text{O}_4)_3]^3$
 (d) $[\text{Cr}(\text{Cl}_2 \cdot (\text{NH}_3)_2 \cdot (\text{en}))]$

Gujarat Board-2019

Ans. (a)

10. Identify the co-ordination compound which can exhibit linkage isomerism, among the following :
 (a) $[\text{Pt}(\text{NH}_3)_2 \text{Cl}_2]$
 (b) $[\text{Co}(\text{NH}_3)_5 (\text{SO}_4)] \text{Br}$
 (c) $[\text{Co}(\text{NH}_3)_5 (\text{NO}_2)] \text{Cl}_2$
 (d) $[\text{Cr}(\text{NH}_3)_6] [\text{CoF}_6]$

Kerala Board-2019

Ans. (b)

11. Which complex exhibit geometrical isomerism?
 (a) $[\text{MnBr}_4]^{2+}$ (b) $[\text{Pt}(\text{NH}_3)_3 \text{Cl}]^+$
 (c) $[\text{PtCl}_2(\text{P}(\text{C}_2\text{H}_5)_3)_2]$ (d) $[\text{Fe}(\text{H}_2\text{O})_5 \text{NO}]^{2+}$

Haryana Board-2017

Ans. (b)

12. How many ions are given by $[\text{Co}(\text{NH}_3)_5 \text{Br}] \text{Cl}_2$ complex in water?
 (a) 4 (b) 2
 (c) 6 (d) 3

Haryana Board-2016

Ans. (d)

13. Which type of Isomerism present in $[\text{Co}(\text{NH}_3)_4 \text{Cl}_2] \text{NO}_2$ and $[\text{Co}(\text{NH}_3)_4 \text{ClNO}_2] \text{Cl}$:
 (a) Ionic (b) Linkage
 (a) Optical (b) Geometrical

Haryana Board-2018

Ans. (a)

14. Which of the following complex ions does not possess optical isomerism?
 (a) $[\text{Co}(\text{en})_2 (\text{NH}_3)_2]^{2+}$ (b) $[\text{Co}(\text{CO})_4 (\text{en})]^{3+}$
 (c) $[\text{Co}(\text{en})(\text{H}_2\text{O})_4]^{2+}$ (d) $[\text{Co}(\text{H}_2\text{O})_3 \text{Br}_3]^{3+}$

Gujarat Board-2018

Ans.(d) :

15. Which of the following complex will show facial-meridional isomerism?
 (a) $[\text{CO}(\text{NH}_3)_3 (\text{NO}_2)_3]$ (b) $[\text{Pt}(\text{NH}_3)_2 \text{Cl}_2]$
 (c) $[\text{Cr}(\text{NH}_3)_4 \text{Cl}_2] \text{Cl}$ (d) $\text{K}_4[\text{Fe}(\text{CN})_6]$

Gujarat Board-2017

Ans.(a)

16. Which of the following pair is a example of linkage isomerism?
 (a) f
 (b) $[\text{CO}(\text{NH}_3)_5 \text{NO}_3] \text{Cl}$
 and $[\text{CO}(\text{NH}_3)_5 \text{Cl}] \text{NO}_3$
 (c) $[\text{CO}(\text{NH}_3)_6]^{3+} [\text{Cr}(\text{CN})_6]^{3-}$
 and $[\text{Cr}(\text{NH}_3)_6]^{3+} [\text{CO}(\text{CN})_6]^{3-}$
 (d) $[\text{CO}(\text{NO}_2)(\text{NH}_3)_5] \text{Cl}_2$
 and $[\text{CO}(\text{ONO})(\text{NH}_3)_5] \text{Cl}_2$

Gujarat Board-2019

Ans. (d)

26. Give reason for each of the following :
 (a) \pm Butan-2-ol is optically inactive.
 (b) Alkynes are acidic in nature.
- NIOS Board-2014
27. Express Linkage isomerism in $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$.
- Punjab Board-2017
28. Write the Fischer structure of (R)-2-Bromobutane.
- Manipur Board-2019
29. Write the formula of ionisation isomer of $[\text{Cr}(\text{H}_2\text{O})_4\text{Br}_2]\text{Cl}$.
- Rajasthan Board-2015
30. Give the structures of cis- $[\text{CoCl}_2(\text{en})_2]$ and facial- $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$ isomers.
- Rajasthan Board-2013
31. How many geometrical isomers are possible in the following coordination entity?
 $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$
- Assam Board-2020
32. Give chemical tests to show that $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$ are ionisation isomers.
- Assam Board-2018
33. Which types of Isomerism are in $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$.
- MP Board-2016
34. What types of isomer are $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$?
- MP Board-2014
35. What is optical isomerism? Draw the structure of optical isomers of $[\text{Cr}(\text{Ox})_3]^{3-}$
- Nagaland Board-2018
- (iii) Why are low spin tetrahedral complexes rarely observed?
- All India 2017
5. (i) What type of isomerism is shown by the complex $[\text{Co}(\text{en})_3]\text{Cl}_3$?
 (ii) Write the hybridization and magnetic character of $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$. (Atomic number of Co = 27)
 (iii) Write IUPAC name of the following complex $[\text{Cr}(\text{NH}_3)_3 \text{Cl}_3]$.
- Delhi 2017
6. (i) What type of isomerism is shown by the complex $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$?
 (ii) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_o > P$.
 (iii) Write the hybridisation and shape of $[\text{CoF}_6]^{3-}$. (Atomic number of Co = 27)
- All India 2015
7. (i) Draw the geometrical isomers of complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$.
 (ii) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_o < P$.
 (iii) Write the hybridisation and magnetic behaviour of the complex $[\text{Ni}(\text{CO})_4]$. (Atomic number of Ni = 28)
- Delhi 2015
8. (i) Draw the geometrical isomers of complex $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$.
 (ii) On the basis of crystal field theory, write the electronic configuration for d^4 ion, if $\Delta_o > P$.
 (iii) Write the hybridization type and magnetic behaviour of the complex $[\text{Ni}(\text{CN})_4]^{2-}$. (Atomic number of Ni = 28)
- Foreign 2015
9. (b) Draw one of the geometrical isomers of the complex $[\text{Pt}(\text{en})_2 \text{Cl}_2]^{2+}$ which is optically active.
- All India 2014
10. Draw one of the geometrical isomers of the complex $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ which is optically inactive.
- Delhi 2014
11. Name the following complexes and draw the structure of one possible isomer of each:
 (i) $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$
 (ii) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
 (iii) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
 (where en = ethane-1,2-diamine or ethylene diamine)
- Foreign 2012
12. Name the following coordination entities and draw the structures of their stereoisomers.
 (i) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
 (where, en = ethane-1,2-diamine)
 (ii) $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$
 (iii) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
 (Atomic no. of Cr = 24, Co = 27)
- All India 2012

Section-C : Short Answer

1. Chromium (III) forms an octahedral complex with water molecules and chloride ions as ligands. Conductance measurement shows the complex to be non-ionic in nature. Write the IUPAC name of the complex and draw the possible geometrical isomers.
- Manipur Board 2023
2. Draw the geometries of geometrical isomers of $[\text{Pt}(\text{H}_2\text{O})_2\text{Br}_2]$ and write their configurations.
- Rajasthan Board 2023
3. (a) How can you show that complexes $[\text{Co}(\text{NH}_3)_5 \text{Cl}] \text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5 \text{SO}_4] \text{Cl}$ are ionization isomers ?
 (b) Write the formula of the following complex using IUPAC norms :
 Potassium trioxalatochromate (III)
- CBSE-2020
4. (i) What type of isomerism is shown by the complex $[\text{Co}(\text{NH}_3)_5 (\text{SCN})]^{2+}$?
 (ii) Why $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic? (Atomic number of Ni = 28)

13. Write the structures and names of all the stereoisomers of the following compounds:
- $[\text{Co}(\text{en})_3] \text{Cl}_3$
 - $[\text{Pt}(\text{NH}_3)_2 \text{Cl}_2]$
 - $[\text{Fe}(\text{NH}_3)_4 \text{Cl}_2] \text{Cl}$
- All India 2011
14. Three geometrical isomers are possible for $[\text{Co}(\text{en})(\text{H}_2\text{O})_2(\text{NH}_3)_2]^{3+}$. Draw molecular structures of these three isomers and indicate which one of them is chiral.
- IICITS; Foreign 2009
15. Write the types of isomerism exhibited by the following complexes:
- $[\text{Co}(\text{NH}_3)_5 \text{Cl}] \text{SO}_4$
 - $[\text{Co}(\text{en})_3]^{3+}$
 - $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$
- Delhi 2013
16. Draw the structures of optical isomers of each of the following complex ions.
 $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$, $[\text{Pt Cl}_2(\text{en})_2]^{2+}$
 $[\text{Cr}(\text{NH}_3)_2\text{Cl}_2(\text{en})]^+$
- HOTS; Delhi 2014C
17. Indicate the types of isomerism exhibited by the following complexes.
- $[\text{Co}(\text{NH}_3)_5 (\text{NO}_2)]^{2+}$
 - $[\text{Co}(\text{en})_3] \text{Cl}_3$ [where en = ethylene diamine]
 - $[\text{Pt}(\text{NH}_3)_2 \text{Cl}_2]$
- Delhi 2015
18. (i) What type of isomerism is shown by the complex $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$?
(ii) Why a solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green while a solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colourless?
(Atomic number of Ni = 28)
(iii) Write the IUPAC name of the following complex:
 $[\text{Co}(\text{NH}_3)_5 (\text{CO}_3)] \text{Cl}$
- Delhi 2017
19. Draw the structures of the optical isomers of $[\text{CrCl}_2(\text{ox})_2]^{3-}$. Write the formula of Ammine bromido chloride nitrito-N-platinum (II) ion.
- Goa Board-2023
20. Write the IUPAC name of $\text{K}_3 [\text{Cr}(\text{C}_2\text{O}_4)_3]$ isomeric structures of $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$.
- Karnataka Board-2019
21. a) Write the IUPAC name of :
 $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}] \text{Cl}_2$.
b) Explain linkage isomerism with example.
- Karnataka Board-2018
22. i) Write cis and trans isomeric structures of $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^-$
ii) What is the co-ordination number of Fe in $[\text{FeCl}_2(\text{en})_2]\text{Cl}$.
- Karnataka Board-2017
23. a) For the given complex $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$, write the IUPAC name and its ionisation isomer.
b) Which set of d-orbital's of metal ion/atom experience more repulsion in octahedral field created by the ligand?
- Karnataka Board-2015
24. Explain hydrate (solvate) isomerism and linkage isomerism with suitable example.
- Tamil Nadu Board-2018
25. Which type of isomerism is shown by the two complexes $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ and $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$? How would you distinguish between two complexes?
- West Bengal Board-2019
26. Define Geometrical isomerism? Explain it with reference to square planar complexes of $\text{M}_2\text{A}_2\text{BC}$ type.
- J&K Board-2019
27. a) Explain ionization isomerism with an example.
b) What are homolytic complexes?
- Karnataka Board-2016
28. a) What is ambidentate ligand? Name the type of structural isomerism arises when such ligand present in the complex.
b) Write the IUPAC name of $\text{K}_2[\text{Zn}(\text{OH})_4]$.
- Karnataka Board-2018
29. Name the types of isomerism shown by the following pairs of compounds:
- $[\text{Cu}(\text{NH}_3)_4][\text{PtCl}_4]$ and $[\text{Pt}(\text{NH}_3)_4][\text{CuCl}_4]$
 - $[\text{Co}(\text{Pn})_2\text{Cl}_2]^+$ and $[\text{Co}(\text{tn})_2\text{Cl}_2]^+$
- ISC Board-2017
30. Write the structures of the geometrical isomers of the compound $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$.
- Assam Board-2014
31. Tetrahedral heteroleptic complex cannot exhibit geometrical isomerism but may show optical isomerism. Explain with example.
- Manipur Board-2019
32. Draw the structures of the optical isomers of $[\text{CrCl}_2(\text{ox})_2]^{3-}$. Write the formula of Ammine bromido chloride nitrito-N-platinum (II) ion.
- Goa Board-2019
33. (a) Write down the ionization isomer of $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$.
(b). Write the IUPAC name of the above compound.
(c). $[\text{Ni}(\text{CO})_4]$ is diamagnetic while $[\text{NiCl}_4]^{2-}$ is paramagnetic though both are tetrahedral why?
- Kerala Board-2016
34. Write definition of optical isomerism.
- Rajasthan Board-2020
35. Trans isomers are more stable than cis-isomers. Why?
- Tamilnadu Board, Sep.-2016

36. (a) Draw optical and geometrical isomers of $[\text{CoCl}_2(\text{en})_2]^+$
(b) Give evidence that $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)\text{Cl}]$ are ionisation isomers.
- Gujarat Board-2020
37. Draw the geometrical isomers of the complex ion $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$.
- Assam Board-2017
38. Give one example each of the following:
(i) Ionisation isomerism
(ii) Geometrical isomerism
- Assam Board-2015
- 39.(a) Name the isomerism shown by the following pair of coordination compounds –
 $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$
- Assam Board-2012
40. What is ionization isomerism? Give one example
- MP Board-2015
41. Explain hydrate isomerism in coordination compounds with an example.
- J & K Board-2021
42. a. Draw the structures of geometrical isomers of $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^-$
Or
b. Draw the figure to show the splitting of d-orbital ion in octahedral crystal field.
- Nagaland Board-2020
43. Draw the facial and meridional isomer of the complex compound –
 $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$
- Assam Board-2023

Section-E : Long Answer

1. (i) What is the basis of formation of the spectrochemical series?
(ii) Draw the structures of geometrical isomers of the following coordination complexes:
 $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ and $[\text{CoCl}_2(\text{en})_2]^+$
(where en = ethylene diamine and atomic no. of Co is 27).
- All India 2008
2. (i) Draw the structure of cis- $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ and write the hybridization state of Co in the given complex entity.
(ii) Using the IUPAC norm's name the complex $[\text{Co}(\text{NH}_3)_4\text{Cl}(\text{ONO})]\text{Cl}$.
- All India 2008C
3. Explain the following giving an example in each case:
(i) Linkage isomerism.
(ii) An outer orbital complex.
(iii) A bidentate ligand.

Foreign 2009

4. Define : Distereoisomers.
Give cis and trans isomers of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
What is reference electrode ?
Give reason : Bleaching action of ozone is also called dry bleach.
- Maharashtra board-2023
5. (i) List the various structural isomerism possible for co-ordination compounds.
(ii) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is strongly paramagnetic whereas $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic. Explain.
- Kerala Board-2021
6. (a) Draw the structures of geometrical isomers of $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^-$
(b) Write the formula of pentaamminecarbonatocobalt (III) chloride.
(c) Write any two limitations of valance bond theory.
- Kerala Board-2018
7. (i) Draw the geometrical isomers of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
(ii) Describe the four types of structural isomerism exhibited by co-ordination compounds.
- Kerala Board-2022
8. Which isomerism show by $[\text{CO}(\text{NH}_3)_6]$. Write name.
- Rajasthan Board-2017
9. Define linkage and ionization isomerism.
- Rajasthan Board-2017
10. Explain hydridisation, geometrical shape and magnetic property of $[\text{Ni}(\text{NH}_3)_2\text{Cl}_2]$ complex. Draw their isomers.
- Gujarat Board-2018
11. Explain the geometrical structures of tetra cyano and tetrachlorido complexes of Nickle (II) on the basis of magnetic property.
- Gujarat Board-2019

G. Application of Coordination Compounds

Section-A : Multiple Choice Questions

1. The crystal field splitting energy for octahedral (Δ_0) and tetrahedral (Δ_t) complexes is related as
(a) $\Delta_t = \frac{2}{9}\Delta_0$ (b) $\Delta_t = \frac{5}{9}\Delta_0$
(c) $\Delta_t = \frac{4}{9}\Delta_0$ (d) $\Delta_t = 2\Delta_0$
- CBSE-2020
- Ans. (c)
2. Which one of the following is a homoleptic complex?
(a) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
(b) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
(c) $\text{K}_4[\text{Fe}(\text{CN})_6]$
(d) $[\text{Co}(\text{NH}_3)_4\text{Cl}(\text{NO}_2)]\text{Cl}$
- CBSE-2021

Ans. (b)

20. What is the oxidation state of Fe in $K_3[Fe(CN)_6]$?
 (i) +2
 (ii) +3
 (iii) +4
 (iv) +1

Meghalaya Board-2018

Ans. (a)

Section-B : Very Short Answer

1. Write chemical equations involved to obtain :
 (a) Cu from Cu_2S
 (b) Ag from $[Ag(CN)_2]^-$ complex
- CBSE-2020
2. What is crystal field splitting energy? How does the magnitude of Δ_0 decide the actual configuration of d-orbitals in a coordination entity?
- CBSE-2021
3. Which of the following is more stable complex and why?
 $[Co(NH_3)_6]^{3+}$ and $[Co(en)_3]^{3+}$
- All India 2014
4. Explain the following.
 $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2+}$ are of different colours in dilute solutions.
- Foreign 2012
5. What are the (a) oxidation number and (b) coordination number of the metal ion in the following?
 (a) $[Cu(NH_3)_4]^{2+}$
 (b) $[Fe(CN)_6]^{3-}$
- NIOS Board-2015
6. What do you mean by ferromagnetism and anti-ferromagnetism?
- Odisha Board-2023
7. With the help of valence bond theory, explain as to why $[CoF_6]^{3-}$ is paramagnetic, whereas $[Co(NH_3)_6]^{3+}$ is diamagnetic.
 [Atomic number of Co = 27]
- NIOS Board-2014
8. $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2+}$ are of different colours in dilute solutions. Why?
- Punjab Board-2021
9. ions produced from complex compound $K_4[Fe(CN)_6]$?
- Haryana Board-2021
10. What are ligands ?
- Haryana Board-2021
11. Predict which of the following ions will be coloured in aqueous solution. Give reason for each : Cu^+ and Fe^{3+} .

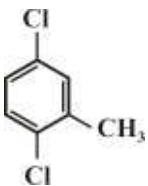
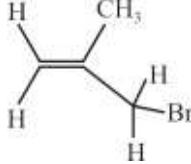
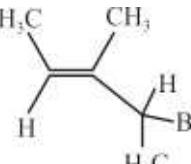
12. How does crystal field theory explain the color of complexes.
- Jharkhand Board-2018
13. Among $[Fe(H_2O)_6]^{3+}$ and $[Fe(C_2O_4)_3]^{3-}$ complex which is more stable and why?
- Haryana Board-2016
14. Explain the reasons of the following:
 (i) $[Fe(CN)_6]^{3-}$ is more stable than $[Fe(CN)_6]^{4-}$
 (ii) Aqueous solution of Ti^{3+} complex ion is violet in colour.
- Rajasthan Board-2010
15. Mention one analytical application of co-ordination compound.
- Assam Board-2018
16. Given one example of a co-ordination compound which is used in medicine.
- Assam Board-2012
17. Write the name of organometallic compound used as an antiknock.
- MP Board-2018
18. How does antiferromagnetism differ from ferromagnetism in terms of magnetic domains?
- Meghalaya Board-2019
19. On the basis of VBT, predict the shape and magnetic behaviour of $[Fe(CN)_6]^{4-}$.
- Nagaland Board-2017

Section-C : Short Answer

1. (i) Write the hybridization and geometry of $[Ni(CN)_4]^{2-}$. (Atomic number of Ni = 28)
 (ii) Write the IUPAC name of the following complex :
 $[Co(NH_3)_5Cl]Cl_2$
 (iii) Why are low spin configurations rarely observed for tetrahedral coordination entities ?
- CBSE-2022
2. (i) Write the electronic configuration of d^5 on the basis of crystal field splitting theory if $\Delta_0 < P$.
 (ii) $[Ni(CN)_4]^{2-}$ with square-planar structure is diamagnetic and $[NiCl_4]^{2-}$ with tetrahedral geometry is paramagnetic. Give reason to support the statement. [Atomic number : Ni = 28]
 (iii) Write the number of ions produced in the solution from the following complex.
 $[PtCl_2(NH_3)_4]Cl_2$
- CBSE-2022

3. (i) Calculate the spin only magnetic moment of the complex $[\text{FeF}_6]^{3-}$. (Atomic number of Fe = 26)
(ii) Write the IUPAC name of the given complex :
 $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
(iii) Why is the complex $[\text{Co}(\text{en})_3]^{3+}$ more stable than $[\text{CoF}_6]^{3-}$?
CBSE-2022
4. (i) Write the electronic configuration of d^5 on the basis of crystal field splitting theory if $\Delta_o < P$.
(ii) $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic whereas $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic. Give reason to support this statement.
[Atomic no. : Fe = 26]
(iii) Write the number of ions produced from the complex $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$ in solution.
CBSE-2022
5. (b) (i) Calculate the spin only magnetic moment of the complex $[\text{CoF}_6]^{3-}$. (Atomic no. of Co = 27)
(ii) Write the IUPAC name of the given complex :
 $[\text{CrCl}_2(\text{H}_2\text{O}_4)]\text{Cl}$
(iii) Which out of the two complexes is more stable and why ?
 $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}, [\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$
CBSE-2022
6. (i) Write the IUPAC name of the following complex : $\text{K}_2[\text{PdCl}_4]$
(ii) Using crystal field theory, write the electronic configuration of d^5 ion, if $\Delta_o > P$.
(iii) What are Homoleptic complexes ?
CBSE-2022
7. What is Electrochemical series? Mention its important applications.
Uttarakhand Board-2020
8. With the help of valence Bond Theory (VBT) explain hybridization, geometry and magnetic property of $[\text{Ni}(\text{CN})_4]^{2-}$ tetracyanido nickelate (II) ion. [Given: Atomic number of Ni = 28].
Karnataka Board-2019
9. Identify to which type does the following complex reactions belongs to:
(i) Dehydration of 2-methyl -2 butanol
(ii) Isomerisation of cyclopropane
(iii) Saponification of a diester in presence of an alkali.
Tamil Nadu Board-2018
10. Calculate spin only magnetic moment of divalent cation of transition metal with atomic number 25.
Salts of Ti^{4+} are colourless. Give reason.
Maharashtra board-2022
11. Explain formations of $[\text{CoF}_6]^{3-}$ complex with respect to
(a) Hybridisation
(b) Magnetic properties
(c) Inner / outer complex
(d) Geometry
Maharashtra board-2023
12. Give IUPAC name, coordination number, oxidation state and magnetic moment of complex $[\text{Cr}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$.
Haryana Board-2016
13. What are transition elements (d-block elements)? Explain giving reasons–
(i) transition metals and many of their compounds show paramagnetic behavior:
(ii) transition metals generally form the coloured compounds.
Chhattisgarh Board-2021
14. $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic. Why?
Chhattisgarh Board-2020
15. Explain the splitting of d-orbitals in a tetrahedral crystal field.
Haryana Board-2016
16. Explain the splitting of d-orbitals in an octahedral crystal field.
Haryana Board-2016
17. Define Homoleptic and Heteroleptic complexes.
Haryana Board-2016
18. Draw the diagram which show the transition of an electron in $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$.
Rajasthan Board-2017
19. What impact takes place on metal complex due to transition of an electron in $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$.
Rajasthan Board-2017
20. Explain the applications of coordination compounds in the field of metal purification giving an example.
Rajasthan Board-2014
21. A solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green but a solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colorless. Explain.
Assam Board-2020
22. What is Zeise's Salt and Ferrocene? Explain with structure.
MP Board-2013

23. Why do transition metals form interstitial compounds? J & K Board-2021
24. Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25. Nagaland Board-2020
25. A coordination compound with molecular formula $\text{CrCl}_3\text{H}_2\text{O}$ precipitates two moles of AgCl with AgNO_3 solution. What is the structural formula of the compound? Assam Board-2023
- Section-E : Long Answer**
1. (i) When MnO_2 is heated with conc. HCl a pungent coloured gas (A) is evolved. (A) reacts with excess NH_3 to give a colourless gas (B). However, when excess (A) is reacted with NH_3 it gives an explosive (C). Identify (A), (B), (C), with equations.
(ii) Arrange the following in the increasing order of the property indicated:
(I) $\text{Xe}, \text{Kr}, \text{Ar}, \text{Ne}, \text{He}$ — Boiling point
(II) $\text{HF}, \text{HCl}, \text{HBr}, \text{HI}$ — Thermal stability CBSE-2021
2. (i) Write the electronic configuration of d^4 on the basis of crystal field splitting theory if $\Delta_o > P$.
(ii) $[\text{Co}(\text{NH}_3)_6]^{3+}$ is an inner orbital complex whereas $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is an outer orbital complex.
(iii) Write the number of ions produced from the complex $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$ in solution. CBSE-2022
3. Explain $[\text{Ni}(\text{CN})_4]^{2-}$ is square planar whereas $[\text{NiCl}_4]^{2-}$ tetrahedral. Gujarat Board-2016
4. (a) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ complex is paramagnetic whereas $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic. Explain on the basis of crystal field theory.
(b) Write the IUPAC name, coordination number and oxidation state of cobalt in $[\text{Co}(\text{en})_2(\text{H}_2\text{O})\text{CN}]^{2+}$.
(c) What is linkage isomerism ? Give one example.
[Atomic number : Fe = 26, Co = 27] NIOS Board-2021
5. (a) Write the state of hybridization, the shape and magnetic behaviour of the following complexes:
(i) $[\text{CoCl}_4]^{2-}$ (ii) $[\text{Ni}(\text{CN})_4]^{2-}$ Meghalaya Board-2021
- (b) Draw the geometrical isomers of $[\text{Cr}(\text{en})_2\text{Cl}_2]^+$ complex.
(c) Write the IUPAC name of $[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]^+$ NIOS Board-2019
6. Write name, the geometry and magnetic behaviour of each of the following complexes :
(i) $[\text{Pt}(\text{NH}_3)_2\text{ClNO}_2]$
(ii) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
(iii) $\text{Ni}(\text{CO})_4$ NIOS Board-2022
7. For the complex $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$ (Where en = ethane 1-2 diamine) answer the following:
(a) The oxidation number of Cobalt
(b) The hybrid orbitals and shape of the complex
(c) The magnetic behaviour of the complex
(d) Write down the geometrical isomers and optical isomers of the complex
(a) Write IUPAC name of the complex. (At. NO of Co = 27) NIOS Board-2023
8. For the complex $[\text{Fe}(\text{en})_2\text{Cl}_2]\text{Cl}$, identify the following (Where en =ethane 1, 2 – diamine)
(i) Oxidation state and coordination number of iron
(ii) Hybrid orbitals and shape of complex
(iii) Magnetic behaviour of complex on the basis of CFT
(iv) Its geometrical and optical isomers
(v) IUPAC name of the complex.
(At. No. of Fe = 26) NIOS Board-2023
9. Draw the structures of optical of $[\text{Pt}(\text{Cl}_2(\text{en})_2)]^{2+}$. Using Valence Bond Theory, deduce the hybridization scheme of the outer orbital complex $[\text{CoF}_6]^{3-}$. Comment on its magnetic behaviour. Goa Board-2018
10. (a) What is a ligand? Give one example each of a bidentate and an ambidentate ligand.
(b) Explain on the basis of VBT, why tetrahedral Ni(II) complexes are paramagnetic but square planar Ni(II) complexes are diamagnetic.
(c) According to CFT, what happens to the degeneracy of the d-orbitals in the presence of asymmetrically negative field due to the ligands.

8. Draw the structures of the following organic halogen compounds:
 (i) 4-tert-butyl-3-iodoheptane
 (ii) 4-bromo-3-methylpent -2-ene
- All India 2014C
9. Write the IUPAC names of the following compound:
 (i) $\text{CH}_2 = \text{CHCH}_2\text{Br}$
 (ii) $(\text{CCl}_3)_3\text{CCl}$
- All India 2014C
10. Write the IUPAC name of $\text{ClCH}_2\text{C} \equiv \text{CCH}_2\text{Br}$.
- All India 2008C
11. Write the structure of 1-bromo-4-chlorobut-2-ene.
- Delhi 2017
12. Write the structure of 3-bromo-2- methylprop-1-ene.
- Delhi 2017
13. Draw the structure of 2-bromopentane.
- Delhi 2014C
14. Write the IUPAC name of $(\text{CH}_3)_2\text{CH CH(Cl)CH}_3$.
- Delhi 2013
15. Write the IUPAC name of $\text{CH}_3 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_2 - \text{CH} = \text{CH}_2$
- Delhi 2013
16. Write the IUPAC name of $\text{CH}_3\text{CH} = \text{CH} - \underset{\text{Br}}{\underset{|}{\text{C}}} - \text{CH}_3$
- Delhi 2013
17. Write the IUPAC name of the following compound:
 $\text{CH}_3 - \underset{\text{CH}_3}{\text{C}} - \underset{\text{Cl}}{\text{CH}} - \text{CH}_3$
- All India 2013
18. Write the IUPAC name of the following compound:

- All India 2013
19. Write the IUPAC name of the following compound:
 $\text{CH}_3 - \underset{\text{Br}}{\text{CH}} - \text{CH}_2 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_3$
- All India 2013
20. A hydrocarbon C_5H_{12} gives only one monochlorination product. Identify the hydrocarbon.
- Delhi 2013C
21. Give the IUPAC name of the following compound:
 $\text{CH}_2 = \underset{\text{CH}_3}{\underset{|}{\text{C}}} - \text{CH}_2\text{Br}$
- Delhi 2012
22. What happens when bromine attacks $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{C} \equiv \text{CH}_2$?
 HOTS; All India 2012
23. Write the IUPAC name of the following compound: $(\text{CH}_3)_3\text{CCH}_2\text{Br}$.
- Delhi 2011
24. Write the IUPAC name of the following compound: $\text{CH}_2 = \text{CHCH}_2\text{Br}$.
- All India 2011
25. Draw the structure of 1,4-dibromobut-2-ene.
- Delhi 2011C; All India 2010C
26. Draw the structure of 2-(2-bromophenyl) butane.
- Delhi 2011C
27. Draw the structure of 2-(2-chlorophenyl)-1-iodooctane.
- All India 2011C
28. Draw the structure of the following compound: 1-bromo-4-sec-butyl-2-methylbenzene
 HOTS; All India 2011C
29. Draw the structure of the following organic compound: 2-chloro-3-methylpentane.
- All India 2011C, 2009C
30. Draw the structure of the following compound: 3-(4-chlorophenyl)-2-methyl propane
- Delhi 2011C
31. Write the IUPAC name of the following compound:

- All India 2010, Delhi 2008
32. Give the IUPAC name of the following compound:

- All India 2010; foreign 2009, 2008
33. Draw the structure of the compound, 4-tert-butyl-3- iodoheptane.
- All India 2010C

34. Write the IUPAC name of the following compound:

$$\begin{array}{c} \text{CH}_3 \\ | \\ \text{H}_3\text{C} - \text{C} - \text{CH}_2\text{Cl} \\ | \\ \text{CH}_3 \end{array}$$

All India 2010C

35. Draw the structure of the compound, 1-chloro-4-ethylcyclohexane.

All India 2010C

36. Draw the structure of the following compound:
4-bromo -3- methylpent-2-ene.

Foreign 2010
2 4-

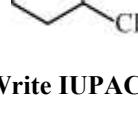
37. Write the structure of 2-dinitrochlorobenzene.

Delhi 2017

34. Write IUPAC name of $\text{CH}_3, \text{C}(\text{C}_2\text{H}_5)_2\text{CH}_2\text{Br}$.

Jharkhand Board-2018

35. Which the IUPAC name of



Karnataka Board-2016

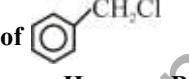
36. Write IUPAC name of $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{l}$.

Jharkhand Board-2019

37. Write the structural formula of the following compound:
1-Bromobut-2-ene.

Assam Board-2014

38. Write IUPAC name of



Haryana Board-2016

39. Write IUPAC name of



Haryana Board-2016

40. Write full name of DDT.

Rajasthan Board-2018

41. Write the structural formula of propane-1, 2, 3-triol.

Assam Board-2016

42. Give the IUPAC name of the following compound:

$$\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CHO}$$

Assam Board-2015

43. Give harmful effects of DDT.

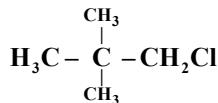
J & K board-2023

44. Draw the structure of 4-bromopent-2-ene.

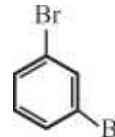
Nagaland Board-2020

45. Give the IUPAC of $\text{CH}_2 = \text{CHCH}_2\text{Br}$.

Nagaland Board-2021



All India 2010C

- (ii) 

(iii) $\text{CH}_2 = \text{CH} - \text{CH}_2\text{Cl}$

All India compartment 2015

2. Write IUPAC name of $\text{CH}_3\text{C}(\text{Cl})\text{(C}_2\text{H}_5)$
 CH_2CH_3

Jharkhand Board-2020

3. Differentiate between configurational and conformational isomers.

Rajasthan Board-2019

4. Explain Geometrical Isomerism found in organic compounds with suitable examples.

Tamilnadu Board, March-2016

5. Draw the structure of S-cis and S-trans form of 1,3 butadiene.

Tamilnadu Board, March-2016

6. Explain R.S nomenclature with illustrations.

Gujarat Board-2017

7. (a) Write the IUPAC name of

$$\text{CH}_3 - \underset{\text{CH}_3}{\text{C}} \text{H} - \underset{\text{Br}}{\text{C}} \text{H} - \text{CH}_3$$

(b) Write one condition for an organic compound to be called a chiral compound.

OR

(c) Explain Wurtz reaction with a suitable example.

Meghalaya Board-2021

Section-E : Long Answer

B. Preparation of Haloalkanes

Section-A : Multiple Choice Questions

Jharkhand Board-2018

Ans. (c)

3. Identify 'A' in the following reaction:
 $A + 2\text{Na} \xrightarrow[\text{ether}]{\text{Dry}} 2,2,5,5 - \text{Tetramethylhexane} + 2\text{NaBr}$
- (a) 2-Bromo - 2 - methylbutane
 (b) 1-Bromo - 2, 2 - dimethylpropane
 (c) 1-Bromo - 3 - methylbutane
 (d) 1-Bromo - 2 - methylpropane

Maharashtra board-2018

Ans. (b)

4. $\text{CH}_3\text{COOH} + \text{SOCl}_2 \rightarrow \text{Product.}$

The product is

- (a) CH_3COCl
 (b) CH_3Cl
 (c) $\text{C}_2\text{H}_5\text{Cl}$
 (d) None of these

Jharkhand Board-2019

Ans. (a)

5. In which reaction there is cleavage of C-O bond?

- (a) Oxidation of alcohol
 (b) Esterification
 (c) Reaction of alcohol with metal
 (d) Reduction of alcohol

Gujarat Board-2018

Ans. (c)

6. $\text{CH}_3\text{CH}_2\text{Cl} + \text{NaI} \xrightarrow{\text{Acetone}} \text{CH}_3\text{CH}_2\text{I} + \text{NaCl}$ The reaction is

- (a) Wurtz reaction
 (b) Finkelstein reaction
 (c) Sandmeyer reaction
 (d) Swarts reaction

Jharkhand Board-2023

Ans. (b)

Section-B : Very Short Answer

1. Write the structure of the isomer that will have the lowest boiling point of all the isomers of $\text{C}_4\text{H}_8\text{Cl}$.

Manipur Board 2020

2. (a) Explain Swarts reaction with an example.
 (b) What are Grignard reagents? Write its general formula.

Karnataka board 2023

3. Draw the resonating structures of chlorobenzene.

ISC Board-2008

4. Give the balanced equation for the following name reaction:
 Wurtz-Fittig reaction

ISC Board-2016

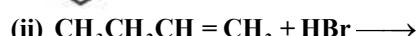
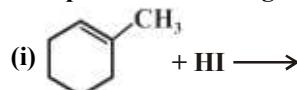
5. Give the balanced equations for the following reaction. 1-butanol and hydrogen chloride (in presence of ZnCl_2)

ISC Board-2012

6. Explain the following reaction with an example: Friedel-Craft's reaction.

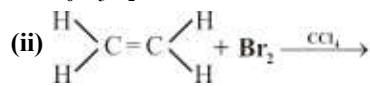
Delhi 2010

7. Complete the following reactions:



All India 2014C

8. Complete the following reactions:



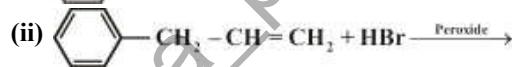
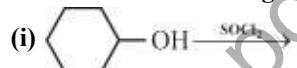
Delhi 2008

All India 2008

9. Write the mechanism of the following reaction:
 $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{HBr}} \text{CH}_3\text{CH}_2\text{Br} + \text{H}_2\text{O}$

Delhi 2014, All India Comportment 2014

10. Draw the structure of major monohalo product in each of the following reactions:



All India 2014

11. Complete the following chemical equation:



Delhi 2008

12. (i) For the preparation of alkyl chlorides from alcohols, thionyl chloride (SOCl_2) is preferred. Give reason.

- (ii) Halo alkanes undergo β -elimination reaction in presence of alcoholic potassium hydroxide.

- (a) Which is the major product obtained by the β -elimination of 2-bromo pentane.
 (b) Name the rule, which leads to the product in the above elimination reaction.

- (iii) Write the chemical equation for the preparation of toluene by Wurtz-Fittig reaction.

Kerala Board-2013

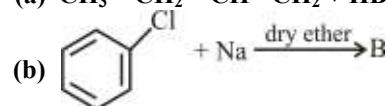
13. Write a short note on Hofmann's bromamide reaction.

Haryana Board-2019

14. $\text{CH}_3\text{Br} + \text{AgF} \rightarrow \dots\dots + \text{AgBr}$

Haryana Board-2021

15. Complete the following equations and write the name of the major products 'A' and 'B'.



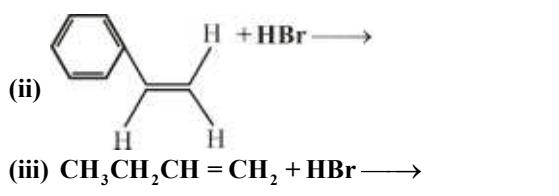
Goa Board-2018

16. What is the action of following on ethyl bromide.

- (i) Na in dry ether
 (ii) Mg in dry ether

Maharashtra board-2022

17. Write the chemical reactions for the following
 (i) Chlorobenzene is heated with fuming H_2SO_4
 (ii) Ethyl bromide is heated with silver acetate
 Maharashtra board-2023
18. Explain Hoffmann bromamide reaction with equation.
 Chhattisgarh Board-2020
19. Fill in the blanks:
 (d) Alkaline solution of HgCl_2 and KI is called.....
 MP Board-2016
20. Identify the products A and B formed in the following reaction :
 $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_3 + \text{HCl} \rightarrow \text{A} + \text{B}$
 Meghalaya Board-2019
21. Write two significances of Hoffmann bromamide degradation reaction.
 Assam Board-2023
22. Explain S_{N}^2 reaction mechanism of haloalkanes.
 Nagaland Board-2018
23. Arrange the following alkyl halids in order of increasing reactivity towards the nucleophilic substitution ($\text{S}_{\text{N}}2$) :
 $\text{CH}_3\text{Cl}, (\text{CH}_3)_3\text{CCl}, (\text{CH}_3)_2\text{CHCl}$
 Meghalaya Board-2018



All India compartment 2015
 Trans-isomer is more stable than cis-isomer,
 Why?

Tamil Nadu Board-2011

6. What is a racemic mixture? Give an example.
 Tamil Nadu Board-2018

7. Which compound in each of the following pairs will react faster in S_{N}^2 reaction with OH^- ?

(i) CH_3Br (or) CH_3I
 (ii) $(\text{CH}_3)_3\text{CCl}$ (or) CH_3Cl

Andhra Pradesh Board-2019

8. How chloroalkanes are prepared from Alcohols and Thionyl chloride? What is the function of anhydrous ZnCl_2 ?
 J&K Board-2019

9. Write the equation of formation of alkyl halide from alcohol with the following reagents :

- (a) SOCl_2
 (b) PCl_3
 (c) HCl

Chhattisgarh Board-2022

10. (i) How are the following conversions carried out?
 A. Propene to Propan-2-ol.
 B. Ethanal to Ethanol.

(ii) Name the enzyme which converts glucose to ethanol:
 Kerala Board-2021

11. Identify the main product in the following reactions:

- (i) $\text{CH}_3 - \text{CH}_2 - \text{OH} \xrightarrow{\text{PCl}_3} \text{?}$
 (ii) $\text{CH}_3 - \text{CH} = \text{CH}_2 \xrightarrow{\text{HI}} \text{?}$

Kerala Board-2021

12. Predict the product :
 (a) $\text{CH}_3, \text{CH}_2, \text{Br} + \text{KCN} \xrightarrow{\text{aq. ethanol}} \text{?}$
 (b) $(\text{CH}_3)_3\text{C} - \text{OC}_2\text{H}_5 \xrightarrow{\text{HI}} \text{?}$
 (c) $\text{CH}_3\text{COONa} \xrightarrow[\text{CaO,A}]{\text{NaOH}} \text{?}$

Jharkhand Board-2019

13. How will you bring about the following transformations?

- (a) Methyl alcohol to Methyl iodide
 (b) Ethyl bromide to Ethene
 (c) Benzyl bromide to Benzyl cyanide.

Jharkhand Board-2019

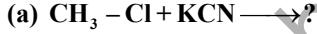
14. (i) Write a suitable method to convert.
 $\text{CH}_3 - \text{CH}_2 - \text{Br}$ to $\text{CH}_3 - \text{CH}_2 - \text{I}$

(ii) Suggest and explain a suitable mechanism for the nucleophilic substitution of tert-butyl bromide with NaOH .

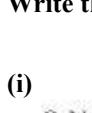
Kerala Board-2022

Section-C : Short Answer

1. Explain Swarts reaction by any one example.
 Rajasthan Board 2023
2. (i) Which compound in each of the following pairs will react faster towards $\text{S}_{\text{N}}2$ reaction with $-\text{OH}$ group?
 (a) CH_3Br or CH_3I
 (b) $(\text{CH}_3)_3\text{CCl}$ or CH_3Cl
- (ii) Write the product (s) of the following reactions.

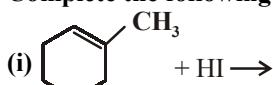


Delhi 2014C

3. Write the major product (s) in the following:
- (i)
- 
- $\xrightarrow[\text{Br}_2, \text{UV light}]{\text{CH}_2 - \text{CH}_3} ?$
- (ii) $2\text{CH}_3 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_3 \xrightarrow[\text{Dry ether}]{\text{Na}} ?$
- (iii) $\text{CH}_3 - \text{CH}_2 - \text{Br} \xrightarrow{\text{AgCN}} ?$

Delhi 2015C

4. Complete the following reactions:



15. (i) What are Grignard reagents?
(ii) State Saytzeff rule and illustrate it with an example.

Kerala Board-2022

26. (a) Which is the major product obtained when 2-bromopentane is heated with alcoholic solution of potassium hydroxide?
(b) Name and state the rule that governs the formation of major product.

Kerala Board-2020

27. In the presence of light, chloroform is slowly oxidized by air to an extremely poisonous gas called _____.

Kerala Board-2020

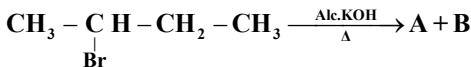
28. Write only chemical equation:
(a) Preparation of phenol from cumene
(b) Preparation of picric acid from phenol

Chhattisgarh Board-2020

29. Give any two chemical reactions of chlorobenzene

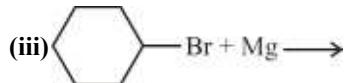
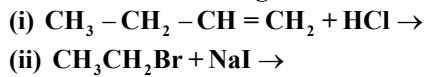
J & K Board-2021

30. Write the products of the following reaction. Which one is the major product and why?



Meghalaya Board-2019

31. (a) Write the structures of the major products of the following reactions:

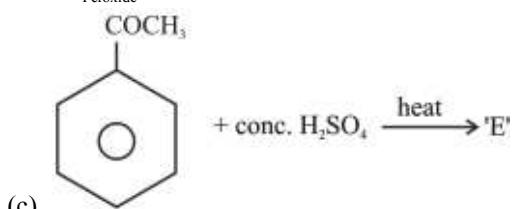
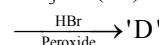
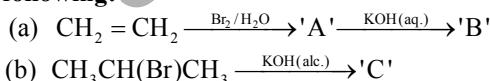


Meghalaya Board-2021

32. (b) What happens when  reacts with the following (Give equations only):
(i) CH_3Cl in presence of anhydrous AlCl_3 ;
(ii) conc. HNO_3 and conc. H_2SO_4 ;
(iii) Na and RX in the presence of dry ether?

Meghalaya Board-2021

33. Identify 'A', 'B', 'C' 'D' and 'E' in the following:



Jharkhand Board-2023

Section-E : Long Answer

1. Write the equations for the preparation of 1-iodobutane from

- (i) 1-butanol
(ii) 1-chlorobutane
(iii) But-1-ene

Gujarat Board-2021

2. (ii) Identify 'A' and 'B' in the following reaction and rewrite the complete reaction.



- (iii) Explain Hoffmann bromamide degradation reaction.

Maharashtra board-2018

3. (i) Give two differences between $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions.
(ii) Arrange 1-chloropropane, 2-chloropropane and 1-chlorobutane in the increasing order of their boiling points.

- (iii) Given one use of chloroform.

Kerala Board-2021

4. Write three chemical reactions for preparation of Alkyl halides from Alcohols. (Indicate by products if any).

Gujarat Board-2020

C. Properties of Haloalkanes

Section-A : Multiple Choice Questions

1. Which compound has highest reactivity towards $\text{S}_{\text{N}}2$ reaction?

- (a) 1-Bromo-13-methylbutane
(b) 1-Bromo-2methylbutane
(c) 1-Bromobutane
(d) 1-Bromo-2,2-dimethylpropane

Gujarat Board 2023 (March)

Ans. (c)

2. Which compound is optical active?

- (a) 2-bromo butane (b) 1-bromo butane
(c) 2-bromo propane (d) 1- bromo propane

Gujarat Borad-2022 (July)

Ans. (a)

3. The name of CF_2Cl_2 in freon method is –

- (a) Freon 112 (b) Freon 12
(c) Freon 122 (d) Freon 11

Rajasthan Board 2023

Ans. (b)

4. Racemisation occurs in

- (a) $\text{S}_{\text{N}}2$ reaction
(b) $\text{S}_{\text{N}}1$ reaction
(c) Neither $\text{S}_{\text{N}}2$ nor $\text{S}_{\text{N}}1$ reactions
(d) $\text{S}_{\text{N}}2$ reaction as well as $\text{S}_{\text{N}}1$ reaction

CBSE-2020

Ans. (b)

5. Iodoform is formed on warming I_2 and NaOH with

- (a) $\text{C}_2\text{H}_5\text{OH}$ (b) CH_3OH
(c) HCOOH (d) $\text{C}_6\text{H}_5\text{CH}_3$

NIOS Board-2018

Ans. (a)

6. What is tincture of iodine ?

- (a) 0.2 to 0.4 ppm aqueous solution of chlorine
- (b) 2-3% aqueous solution of CH_3COOH
- (c) 2-3% solution of iodine in alcohol-water
- (d) none of the above

Haryana Board-2019

Ans. (c)

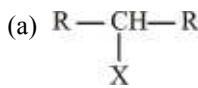
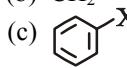
7. Organic compound which shows complete stereochemical inversion during S_{N}^2 reaction :

- (a) $\text{CH}_3 - \text{Cl}$
- (b) $(\text{CH}_3)_2 \text{CH} - \text{Cl}$
- (c) $(\text{CH}_3)_3 \text{C} - \text{Cl}$
- (d) None of the above

Haryana Board-2021

Ans. (a)

8. The allylic halide, among the following is _____.

- (a) 
- (b) $\text{CH}_2 = \text{CH} - \text{X}$
- (c) 
- (d) $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{X}$

Maharashtra board-2023

Ans. (d)

9. Organic compound which shows complete stereochemical inversion during SN^2 reaction:

- (a) CH_3Cl
- (b) $(\text{CH}_3)_2\text{CH}-\text{Cl}$
- (c) $(\text{CH}_3)_3\text{C}-\text{Cl}$
- (d) None of the above

Haryana Board-2017

Ans. (a)

10. A 1° alkyl halide would prefer to undergo:

- (a) SN^2
- (b) SN^1
- (c) Elimination
- (d) None of these

Haryana Board-2017

Ans. (a)

11. In the given Alkyl halides which one has minimum boiling point?

- (a) $\text{C}_2\text{H}_5\text{F}$
- (b) $\text{C}_2\text{H}_5\text{I}$
- (c) $\text{C}_2\text{H}_5\text{Cl}$
- (d) $\text{C}_2\text{H}_5\text{Br}$

Haryana Board-2018

Ans. (a)

12. Which of the following compound is optically inactive?

- (a) Glyceraldehyde
- (b) Lactic acid
- (c) Propanoic acid
- (d) Glucose

Gujarat Board-2018

Ans. (c) :

13. Which compound is optically active?

- (a) Butan-1-amine
- (b) Butan-2-amine
- (c) 2-methylpropan-1-amine
- (d) 2-methylpropan-2-amine

Gujarat Board-2019

Ans. (b)

14. The product formed when aniline is warmed with chloroform and caustic potash.

- (a) Phenyl chloride
- (b) Methyl isocyanide
- (c) Phenyl isocyanide
- (d) Nitrophenol

ISC Board-2002, 2010

Ans. (c)

15. Which of the following is an example of vinylic-dihalide?

- (a) Dichloro ethane
- (b) 1,2-dichloroethene
- (c) Ethylene chloride
- (d) Allyl chloride

Nagaland Board-2020

Ans. (b)

Section-B : Very Short Answer

1. Write down chemical equations to prepare following substances from 1-Chloropropane

- (a) Propene
- (b) Propan-1-ol

Gujarat Board 2023 (March)

2. In the following pairs of halogen compound which would undergo SN^2 reaction faster?

- (i)  and 
- (ii)  and 

Haryana Board 2023

3. Write short notes on following :

- (i) Freon
- (ii) D.D.T.

(i) How chloroform is stored for safe storage?

(ii) Write I.U.P.A.C. name of CHCl_3 and CHI_3 .

MP Board 2020

4. (i) Identify the major and minor product obtained by the reaction between 2-bromo butane and alcoholic KOH.

(ii) Name and state the rule behind the formation of these products.

Kerala Board 2023

5. Differentiate between $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions.

Kerala Board 2023

6. $\text{CH}_3 - \text{CH}_2 - \text{Br} + \text{NaI} \xrightarrow{\text{Acetone}} \text{CH}_3 - \text{CH}_2 - \text{I} + \text{NaBr}$

The name of this reaction is _____

Kerala Board 2023

7. The value of optical rotation of racemic mixture is _____.

Rajasthan Board 2022

8. Write $\text{S}_{\text{N}}2$ mechanism for conversion of chloromethane to methanol.

Karnataka board 2023

9. Define the term racemic mixture.

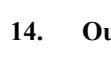
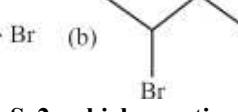
Karnataka board 2023

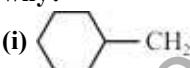
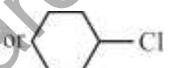
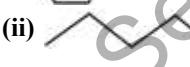
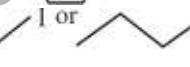
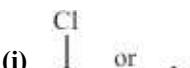
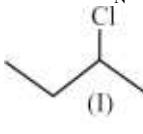
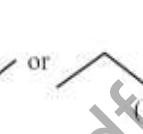
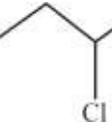
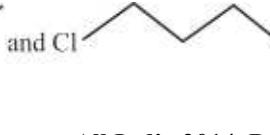
10. Write the IUPAC name of $\text{CH}_3 - \text{O} - \text{C}_2\text{H}_5$.

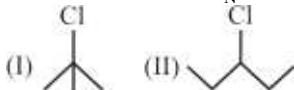
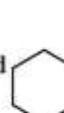
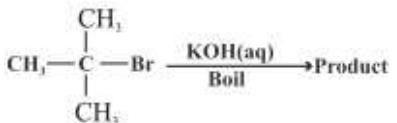
Karnataka board 2023

12. Why Chlorine atom present in Chlorobenzene is less reactive than Chlorine atom present in Ethyl Chloride?

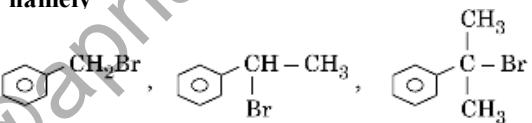
Uttarakhand Board 2023

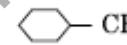
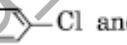
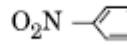
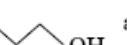
13. Clarify-
- Alkyl Halides though polar are immiscible in water. Why?
 - What happens when Chlorobenzene is subjected to Hydrolysis
- Uttarakhand Board 2022
14. Out of  and  which one is more reactive towards S_N1 reaction ?
- CBSE-2020
15. Out of o-dichlorobenzene and p-dichlorobenzene, which has higher melting point ?
- CBSE-2020
16. How will you convert:
- Phenol to Picric acid
 - Ethanal to Propane-2-OI
- CBSE-2020
17. (b) Write the structures of A, B and C in the following reactions :
- $\text{CH}_3\text{CH}_2\text{Cl} \xrightarrow{\text{KCN}} \text{A} \xrightarrow{\text{LiAlH}_4} \text{B} \xrightarrow[0^\circ\text{C}]{\text{HNO}_2} \text{C}$
 - $\text{CH}_3\text{COOH} \xrightarrow[\Delta]{\text{NH}_3} \text{A} \xrightarrow[(\text{b})\text{H}_2\text{O}]{(\text{a})\text{LiAlH}_4} \text{B} \xrightarrow{\text{C}_6\text{H}_5\text{SO}_2\text{Cl}} \text{C}$
- CBSE-2022
18. Give reasons:
- An increase in temperature is observed on mixing chloroform and acetone.
 - Aquatic animals are more comfortable in cold water than in warm water.
- CBSE-2019
19. Out of Chlorobenzene and Cyclohexyl chloride, which one is more reactive towards nucleophilic substitution reaction and why ?
- CBSE-2019
20. Write one stereochemical difference between S_N1 and S_N2 reactions.
- CBSE-2019
21. Define ambident nucleophile with an example.
- CBSE-2019
22. Predict the major product obtained when t-butyl bromide reacts with sodium methoxide. Also, give its IUPAC name.
- CBSE-2019
23. What happens when
- PCl_5 is heated?
 - XeF_2 reacts with PF_5 ?
- CBSE-2019
24. Which alkyl halide from the following pair would you expect to react more rapidly by an S_N2 mechanism ?
- $\text{CH}_3-\text{CH}_2-\underset{\substack{| \\ \text{CH}_3}}{\text{CH}}-\text{Br}$ or $\text{CH}_3-\underset{\substack{| \\ \text{CH}_3}}{\text{C}}-\text{Br}$
- CBSE-2019
25. (a) Write equation for preparation of 1-iodobutane from 1-chlorobutane.
- (b) Out of 2-bromopentane, 2-bromo-2-methylbutane and 1-bromopentane, which compound is most reactive towards elimination reaction and why?
- (c) Give IUPAC name of
- $$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{CH}=\text{CH}-\underset{|}{\text{C}}-\underset{|}{\text{CH}_3} \\ | \\ \text{Br} \end{array}$$
- CBSE-2019
26. How can you prepare Cl_2 from HCl and HCl from Cl_2 ? Write reactions only.
- CBSE-2019
27. Why is t-butyl bromide more reactive towards S_N1 reaction as compared to n-butyl bromide ?
- CBSE-2019
28. Why is chloroform kept in dark coloured bottles ?
- CBSE-2019
29. Suggest a possible mechanism for the following reaction:
- $n\text{-BuBr} + \text{KCN} \xrightarrow{\text{EtOH}, \text{H}_2\text{O}} n\text{-BuCN}$
- ISC Board-2008, 2009
30. How can the following conversion be brought about methyl chloride to acetone.
- ISC Board-2016
31. Write the balanced equation for the preparation of DDT.
- ISC Board-2008
32. What will be the product formed when chlorobenzene is heated with sodium metal in the presence of dry ether?
- ISC Board-2015
33. How can the following conversions be brought about? Chlorobenzene to phenol
- ISC Board-2015
34. The reaction of chlorine with methane is a reaction which involves fission of the C-H bond.
- ISC Board-2000, 2007
35. (i) Which alkyl halide from the following pair is chiral and undergoes faster towards S_N2 reactions?
- (a)  (b) 
- (ii) Out of S_N1 and S_N2, which reaction occurs with
- inversion of configuration?
 - Racemisation?
- All India 2014
36. Write chemical equations when
- ethyl chloride is treated with aqueous KOH.
 - chlorobenzene is treated with CH_3COCl in the presence of anhydrous AlCl_3 .
- Foreign 2014

37. (i) Which alkyl halide from the following pair would you expect to react more rapidly by an S_N2 mechanism and why?
- $\text{CH}_3 - \text{CH}_2 - \underset{\substack{| \\ \text{Br}}}{\text{CH}} - \text{CH}_3$
- $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \underset{\substack{| \\ \text{Br}}}{\text{CH}_2} - \text{Br}$
- (ii) Racemisation occurs in S_N1 reactions. Why?
- Foreign 2014
38. Which compound in each of the following pairs will react faster towards S_N2 reactions with OH^- ? Why?
- (i) CH_3Br or CH_3I
 (ii) $(\text{CH}_3)_3\text{CCl}$ or CH_3Cl
- Delhi 2014, AI 2014, All India 2010C; Delhi 2008
39. Write the chemical equations when,
- (i) methyl chloride is treated with AgNO_2 .
 (ii) bromo benzene is treated with CH_3Cl in the presence of anhydrous AlCl_3 .
- Foreign 2014
40. What are ambident nucleophiles? Give an example.
- All India 2013; Foreign 2012
41. Account for the following:
- (i) The C – Cl bond length in chlorobenzene is shorter than that in CH_3Cl .
 (ii) Chloroform is stored in closed dark brown bottles.
- Delhi 2013
42. Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction. Give two reasons for the same.
- Delhi 2013
43. Explain. Why
- (i) alkyl halides, though polar, are immiscible with water?
 (ii) Grignard's reagent should be prepared under anhydrous conditions?
- Foreign 2012
44. Which one in the following pairs of substances undergoes S_N2 substitution reaction faster and why?
- (i)  or 
- (ii)  or 
- Delhi 2009
45. Which one in the following pairs undergoes S_N1 substitution reaction faster and why?
- (i)  or 
- (ii)  or 
- All India 2009
46. Suggest a possible mechanism for the following reaction:
- $\text{n-BuBr} + \text{KCN} \xrightarrow{\text{EtOH}, \text{H}_2\text{O}} \text{n-BuCN}$
47. Suggest a possible reason for the following observations:
- (i) The order of reactivity of haloalkanes is $\text{Rl} > \text{RBr} > \text{RCl}$.
 (ii) neo-pentyl chloride, $(\text{CH}_3)_3\text{C}-\text{CH}_2\text{Cl}$ does not follow S_N2 mechanism.
- Delhi 2009C
48. Discuss the mechanism of S_N1 reaction of haloalkanes.
- Delhi 2008C
49. (i) Why is it that haloalkanes are more reactive than haloarenes toward nucleophiles?
 (ii) Which one of the following react faster towards S_N1 reaction and why?
-  (I) or  (II)
- Delhi 2008
50. A solution of KOH hydrolyses $\text{CH}_3\text{CHClCH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$. Which one of these is more easily hydrolysed?
- Foreign 2010; Delhi 2010
51. Out of $\text{CH}_3 - \underset{\substack{| \\ \text{CH}_3}}{\text{CH}} - \text{CH}_2 - \text{Cl}$ and $\text{CH}_3 - \text{CH}_2 - \underset{\substack{| \\ \text{CH}_3}}{\text{CH}} - \text{Cl}$, which is more reactive towards S_N1 reaction and why?
- Delhi 2016
52. Which would undergo S_N1 reaction faster in the following pair?
- $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Br}$ and $\text{CH}_3 - \underset{\substack{| \\ \text{Br}}}{\text{CH}} - \text{CH}_3$
- All India 2015
53. Which would undergo S_N2 reaction faster in the following pair and why?
- $\text{CH}_3 - \text{CH}_2 - \text{Br}$ and $\text{CH}_3 - \underset{\substack{| \\ \text{Br}}}{\text{C}} - \text{CH}_3$
- Delhi 2015, Foreign 2015
54. Which would undergo S_N2 reaction faster in the following pair and why?
- $\text{CH}_3 - \text{CH}_2 - \text{Br}$ and $\text{CH}_3 - \text{CH}_2 - \text{I}$
- Foreign 2015
55. Identify the chiral molecule in the following pair.
-  and 
- All India 2014, Delhi 2014
56. What happens when $\text{CH}_3 - \text{Br}$ is treated with KCN ?
- Delhi 2013

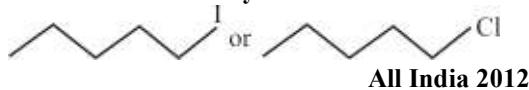
57. What happens when ethyl chloride is treated with aqueous KOH?
Delhi 2013
58. Which compound in the following pair undergoes faster towards S_N1 reactions?

 Delhi 2013
59. How methyl bromide be preferentially converted to methyl isocyanide?
Delhi 2013C
60. Predict the order of reactivity of four isomeric bromobutanes in S_N1 reaction.
Delhi 2012C
61. Write a chemical reaction in which the iodide ion replaces the diazonium group in a diazonium salt.
HOTS; All India 2008; Delhi 2008
62. Out of  and  which is an example of allylic halide?
All India 2017
63. Discuss the mechanism of S_N2 reaction.
Odisha Board-2020
64. Write a note on D.D. T.
Odisha Board-2023
65. Give the product and draw the mechanism for the following reaction

 Manipur Board-2018
66. Give reason. In case of optically active alkyl halides S_N1 reactions are accompanied by racemisation.
Karnataka Board-2020
67. Compare and explain the reactivity
Punjab Board-2021
68. Different alcohols towards sodium.
Punjab Board-2021
69. Among $CH_3CH_2CH_2CH_2I$ and $CH_3CH_2CH_2CH_2Cl$ will show S_N2 reaction fast.
Haryana Board-2022
70. 2 - Bromobutane is optically active. Explain the stereo - chemical aspect of S_N1 reaction of 2-Bromobutane with OH^- ions.
Kerala Board-2019
71. Why halogens are coloured?
Chhattisgarh Board-2020
72. Give reasons:
 (i) C—Cl bond length in chlorobenzene is shorter than C—Cl bond length in chloromethane.
Assam Board-2020
73. Give reasons:
 (ii) Haloalkanes easily dissolve in organic solvents.
Assam Board-2020
74. Define enantiomers.
Assam Board-2016
75. Explain S_N2 mechanism in haloalkanes.
Nagaland Board-2020
76. Arrange the following in order of decreasing S_N1 reactivity :
 $(CH_3)_3CCl$, CH_3Cl , $(CH_3)_2CHCl$, CH_3CH_2Cl
Meghalaya Board-2019
77. Write the name of the catalyst used during synthesis of Cl_2 from HCl by Deacon's process.
Assam Board-2023
78. Explain S_N1 or substitution nucleophilic unimolecular reaction in haloalkanes.
Nagaland Board-2021

Section-C : Short Answer

79. Why does the reaction of CH_3ONa with $(CH_3)_3C - Br$ give 2-methylpropene and not $(CH_3)_3C - OCH_3$?
Gujarat Board 2023 (July)
80. Justify and arrange the following compounds namely

 in increasing order of reactivity towards the asked displacement namely :
 (a) S_N1
 (b) S_N2
CBSE-2020
81. Justify and arrange the following compounds of each set in increasing order of reactivity towards the asked displacement :
 (a) 1-Bromobutane, 2-Bromobutane, 2-Bromo-2-Methylpropane (S_N1 reaction)
 (b) 1-Bromobutane, 2-Bromobutane, 2-Bromo-2-Methylpropane (S_N2 reaction)
CBSE-2020
82. Define the following :
 (a) Racemic mixture
 (b) Enantiomers
Telangana Board-2017
83. (a) Define the following terms :
 (i) Enantiomers
 (ii) Racemic mixture
 (b) Why is chlorobenzene resistant to nucleophilic substitution reaction?
CBSE-2019
84. An aromatic compound 'A' on treatment with $CHCl_3$ and KOH gives two compounds, both of which give same product 'B' when distilled with Zinc dust. Oxidation of 'B' gives 'C' with molecular formula $C_7H_6O_2$. Sodium salt of 'C' on heating with soda lime gives 'D' which may also be obtained by distilling 'A' with Zinc dust. Identify 'A', 'B', 'C' and 'D'.
CBSE-2019

85. Among all the isomers of molecular formula C_4H_9Br , identify
 (a) the one isomer which is optically active.
 (b) the one isomer which is highly reactive towards S_N^2 .
 (c) the two isomers which give same product on dehydrohalogenation with alcoholic KOH.
- CBSE-2019
86. Among all the isomers of molecular formula C_4H_9Br , identify
 (a) the one isomer which is optically active.
 (b) the one isomer which is highly reactive towards S_N^2 .
 (c) the two isomers which give same product on dehydrohalogenation with alcoholic KOH.
- CBSE-2019
87. (i) Out of $(CH_3)_3C-Br$ and $(CH_3)_3C-I$, which one is more reactive towards S_N^1 and why ?
 (ii) Write the product formed when p-nitrochlorobenzene is heated with aqueous NaOH at 443 K followed by acidification.
 (iii) Why dextro and laevo – rotatory isomers of Butan-2-ol are difficult to separate by fractional distillation ?
- CBSE-2019
88. (a) Out of chlorocyclohexane and chlorobenzene, which one is more reactive towards nucleophilic substitution reaction and why ?
 (b) Predict all alkenes that would be formed by the dehydrohalogenation of 2-bromobutane.
 (c) Chloroform contains chlorine but it does not give white precipitate with silver nitrate solution. Why ?
- CBSE-2019
89. Account for the following:
 (a) Benzyl chloride is highly reactive towards S_N^1 reaction
 (b) Racemic mixture is optically inactive
 (c) The presence of nitro group at ortho/para positions increases the reactivity of haloarenes towards nucleophilic substitution reaction.
- CBSE-2019
90. Account for the following:
 (a) Although chlorine is an electron withdrawing group, yet it is ortho, para directing in electrophilic aromatic substitution reaction.
 (b) Alkyl halides are better solvents than aryl halides
 (c) Why is it necessary to avoid even traces of moisture during the use of Grignard's reagent?
- CBSE-2019
91. Give reasons for the following:
 (a) The presence of $-NO_2$ group at ortho or para position increases the reactivity of haloarenes towards nucleophilic substitution reactions.
 (b) p-dichlorobenzene has higher melting point than that of ortho or meta isomer.
 (c) Thionyl chloride method is preferred for preparing alkyl chloride from alcohols.
- CBSE-2019
92. When dilute ferrous sulphate solution is added to an aqueous solution containing nitrate ion followed by careful addition of concentrated sulphuric acid along the sides of test tube, a brown ring is formed at the interface between the solution and sulphuric acid layers. Which anion is confirmed by the appearance of brown ring ? What is the composition of the brown ring ?
- CBSE-2019
93. (a) Out of  and , which one is more reactive towards S_N^2 reaction and why ?
 (b) Out of  and , which one is more reactive towards nucleophilic substitution reaction and why ?
 (c) Out of  and , which one is optically active and why ?
- CBSE-2019
94. Give reasons for the following:
 (i) Ethyl iodide undergoes S_N^2 reaction faster than ethyl bromide.
 (ii) (\pm) 2-butanol is optically inactive.
 (iii) C-X bond length in halobenzene is smaller than C-X bond length in CH_3-X .
- All India 2013
95. Explain the following:
 (i) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
 (ii) Alkyl halides, though polar, are immiscible with water.
 (iii) Grignard's reagents should be prepared under anhydrous conditions.
- Delhi 2013C
96. Although, chlorine is an electron withdrawing group, yet it is ortho, para-directing in electrophilic aromatic substitution reactions. Explain, why is it so?
- Delhi 2012
97. Answer the following questions:
 (i) What is meant by chirality of compound? Give an example.
 (ii) Which one of the following compounds is more easily hydrolysed by KOH and why?
 $CH_3CHClCH_2CH_3$ or $CH_3CH_2CH_2CH_2Cl$

- (iii) Which one undergoes S_N2 substitution reaction faster and why?



All India 2012

98. Answer the following:

- (i) Haloalkanes easily dissolve in organic solvents. Why?
(ii) What is the racemic mixture? Give an example.
(iii) Of the two bromo derivatives, $C_6H_5CH(CH_3)Br$ and $(C_6H_5)CH(C_6H_5)Br$, which one is more reactive towards S_N1 substitution reaction and why?

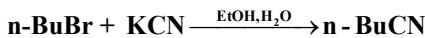
Delhi 2011

99. Rearrange the compounds of each of the following sets in order of reactivity towards S_N2 displacement.

- (i) 2-bromo-2-methylbutane, 1-bromopentane, 2-bromopentane.
(ii) 1-bromo-3-methylbutane, 2-bromo-2-methylbutane, 3-bromo-2-methylbutane.
(iii) 1-bromobutane, 1-bromo-2, 2-dimethylpropane, 1-bromo-2-methylbutane, 1-bromo-3-methylbutane.

All India 2011

100. (i) Write the mechanism of the following reaction:



- (ii) Why is the dipole moment of chlorobenzene lower than that of cyclohexyl chloride?

Delhi 2011C

101. (i) Write a chemical test to distinguish between
(a) chlorobenzene and benzyl chloride
(b) chloroform and carbon tetrachloride
(ii) Why is methyl chloride hydrolysed more easily than chlorobenzene?

All India 2011C

102. (i) State one use of DDT and iodoform.

- (ii) Which compound in the following couples will react faster towards S_N2 displacement and why?
(a) 1-bromopentane or 2-bromopentane
(b) 1-bromo-2-methyl butane or 2-bromo-2-methyl butane

Delhi 2010

103. How would you differentiate between S_N1 and S_N2 mechanism of substitution reactions? Give one example of each.

All India 2010

104. Explain Why

- (i) the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride?
(ii) alkyl halides though polar are immiscible with water?
(iii) in the pair, $(CH_3)_3C-Cl$ and CH_3Cl , CH_3Cl will react faster in S_N2 reactions with —OH?

All India 2010C

105. Give reasons for the following observations:

- (i) p-dichlorobenzene has higher melting point than those of o and m-isomers
(ii) Haloarenes are less reactive than haloalkanes towards nucleophilic substitution reaction.
(iii) The treatment of alkyl chloride with aqueous KOH leads to the formation of alcohol but in the presence of alcoholic KOH, alkene is the major product.

All India 2009; Delhi 2008, 2008C

106. Give reasons.

- (i) C — Cl bond length in chlorobenzene is shorter than C — Cl bond length in CH_3-Cl .
(ii) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
(iii) S_N1 reactions are accompanied by racemisation in optically active alkyl halides.

Foreign 2015

107. How can the following conversions be carried out?

- (i) Aniline to bromobenzene
(ii) Chlorobenzene to 2-chloroacetophenone
(iii) Chloroethane to butane

All India 2015C

108. What happens when

- (i) chlorobenzene is treated with $Cl_2/FeCl_3$?
(ii) ethyl chloride is treated with $AgNO_2$?
(iii) 2-bromopentane is treated with alcoholic KOH?

Write the chemical equations in support of your answer.

All India 2015

109. Give reasons:

- (i) n-butyl bromide has higher boiling point than t-butyl bromide.
(ii) Racemic mixture is optically inactive.
(iii) The presence of nitro group ($-NO_2$) at o/p-positions increases the reactivity of haloarenes towards nucleophilic substitution reactions

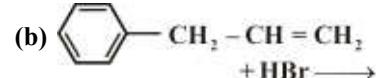
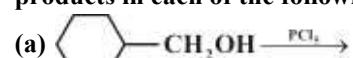
Delhi 2015

110. (i) Why are alkyl halides insoluble in water?

- (ii) Why is butan-1-ol optically inactive but butan-2-ol is optically active?
(iii) Although chlorine is an electron with drawing group, yet it is ortho, para-directing in electrophilic aromatic substitution reactions. Why?

foreign 2015

111. (i) Draw the structures of major monohalo products in each of the following reactions:



- (ii) Which halogen compound in each of the following pairs will react faster towards S_N2 reactions?

- (a) CH_3Br or CH_3I
(b) $(CH_3)_3C-Cl$ or CH_3-Cl

Delhi 2014

112. Following compounds are given to you:
 2-bromopentane,
 2-bromo-2 methylbutane, 1-bromopentane
 (a) Write the compound which is most reactive towards S_N2 reaction.
 (b) Write the compound which is optically active.
 (c) Write the compound which is most reactive towards β -elimination reaction.

Delhi 2017; All India 2017

113. How do you convert the following?
 (i) Chlorobenzene to biphenyl.
 (ii) Propene to 1-iodopropane.
 (iii) 2-bromobutane to but-2-ene.

Delhi 2015

114. Explain S_N1 and S_N2 reactions with an example.

Telangana Board-2023

115. Explain geometrical isomerism with example.

Tamil Nadu Board-2011

116. Distinguish racemic mixture from mesoform.

Tamil Nadu Board-2011

117. What is stereoisomerism? Which type of stereoisomerism is shown by 1,2-dichloroethene? Draw the structures of its two isomers and name them.

NIOS Board-2013

118. (a) Why Haloarenes are less reactive than Haloalkanes ? (Explain with resonance and hybridization).
 (b) Explain substitution nucleophilic bimolecular (S_N2) reaction.
 (c) Define Optical activity.

Punjab Board-2019

119. Explain the following with one example for each
 (a) Wurtz reaction,
 (b) Fitting reaction

Andhra Pradesh Board-2020

120. Complete the following reactions and write the name of the main product formed :
 (i) $CH_3CH_2CH_2Cl \xrightarrow{AgCN} ?$
 (ii) 
 (iii) $CH_3 - C\overset{Cl}{H} - CH_2CH_3$

Goa Board-2019

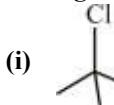
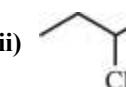
121. Ethanol and methoxymethane are functional isomers. But ethanol has higher boiling point than methoxymethane. Give reason.

Kerala Board-2020

122. The composition of bleaching is $Ca(OCl)_2$, $CaCl_2$, $Ca(OH)_2$. $2H_2O$ Give one method for the preparation of bleaching power.

Kerala Board-2020

123. Answer either (a), (b) and (c) or (d) and (e).
 (a) Explain why Grignard reagents should be prepared under anhydrous condition.
 (b) Which of the following compound would undergo S_N1 reaction faster and why?

(i) 
 (ii) 

(c) What are ambident nucleophiles? Give an example.

Assam Board-2014

124. What is optical isomerism? Explain with one example.

Haryana Board-2017

125. What is chromyl chloride test?

Haryana Board-2017

126. Explain the following:
 (i) Ambident nucleophile
 (ii) Asymmetric carbon

Haryana Board-2016

127. Write hybridized state of carbon bonded to halogen atom in allyl chloride.

128. Explain the mechanism of uni-molecular nucleophilic substitution reaction.

Rajasthan Board-2020

129. Arrange the following alkyl halides in ascending order of their reactivity towards S_N1 reaction.

$CH_3X, CH_3 - CH_2 - X, CH_3 - \underset{X}{CH} - CH_3, CH_3 - C\overset{CH_3}{-} X - CH_3$

(X = same)

Rajasthan Board-2018

130. Write two differences between mechanism of reaction (i) and (ii).

Rajasthan Board-2017

132. Explain S_N1 reaction with appropriate example.

Rajasthan Board-2016

133. What is Saytzeff (Zaitser) rule?
 Explain elimination reaction in 2-bromopentane.

Rajasthan Board-2016

134. Explain why aryl halides are less reactive towards nucleophilic substitution reactions?

Rajasthan Board-2016

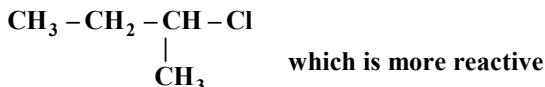
135. Describe any two differences in substitution nucleophilic bimolecular (S_N2) and substitution nucleophilic unimolecular (S_N1) reaction mechanisms.

Rajasthan Board-2014

136. Write the structural formulae of polar and non-polar forms of $C_2H_2Cl_2$.

Rajasthan Board-2010

137. Out of $CH_3 - CH - CH_2 - Cl$ and CH_3



towards $\text{S}_{\text{N}}1$ reaction and why?

Assam Board-2020

138. Give reasons:

- (a) n-Butyl bromide has higher boiling point than t-Butyl bromide.
- (b) Racemic mixture is optically inactive.

Assam Board-2019

139. What are ambident nucleophiles? Give two examples of it.

Assam Board-2019

140. What is racemic mixture? Given one example.

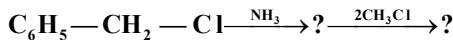
Assam Board-2017

141. In the following halogen compounds, which one will readily undergo $\text{S}_{\text{N}}2$ reaction?



Assam Board-2016

142. Complete the following reaction.



Nagaland Board-2020

Section-D : Case Based Study

1. Discuss the mechanism of unimolecular and bimolecular nucleophilic substitution reactions in haloalkanes.

UP Board 2023

Section-E : Long Answer

2. a) Explain the mechanism of $\text{S}_{\text{N}}1$ reaction taking 2-bromo-2methyl propane (t-butyl bromide)
 b) Explain Wurtz-Fittig's reaction.
 c) Write the general formula of Grignard reagent.

Karnataka Board-2016

3. a) Write the equations for the 2 steps involved in $\text{S}_{\text{N}}1$ mechanism for the conversion of tert-butyl bromide to tert-butyl alcohol.
 b) Aryl halides are less reactive than alkyl halides towards nucleophilic substitution reactions. Give any 2 reasons.
 c) Write the general formula of a Grignard reagent.

Karnataka Board-2020

4. a) Write the equations for the steps involved in $\text{S}_{\text{N}}1$ mechanism for the conversion of tert-butyl bromide to tert-butyl alcohol.
 b) Explain Friedel-Crafts alkylation for chlorobenzene. Give equation.
 c) What is racemic mixtures?

Karnataka Board-2019

5. Discuss the nature of C-X bond in halogens.

Haryana Board-2017

6. Define Pseudounimolecular reaction with an example.

Haryana Board-2018

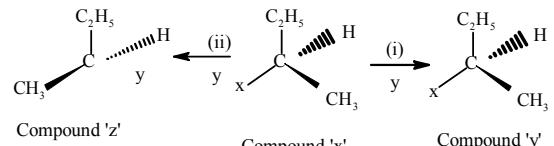
7. Explain the mechanism of bimolecular nucleophilic substitution reaction.

Rajasthan Board-2020

8. Write the chemical equation of following reaction.

- (i) = Wurtz reaction
- (ii) = Finkelstein reaction.

(b)



- (i) Write the names of process to obtain compound (y) and compound (z) from compound (x) in above unclophilin reaction (i) and (ii).

Rajasthan Board-2017

9. Which type of nucleophilic substitution mechanism involved to obtained compound (z) from compound (x). Write the name of mechanism.

Rajasthan Board-2017

10. What do you mean by amonolysis of alkyl halides give chemical reaction?

Rajasthan Board-2016

11. An organic compound (A) (molecular formula $\text{C}_8\text{H}_{16}\text{O}_2$) was hydrolysed with dilute sulphuric acid to give a carboxylic acid (B) and an alcohol (C), Oxidation of (C) with chromic acid produced (B). (C) on dehydration gives but-1-ene. Write equations for the reaction involved. State IUPAC name of compound (A).

Gujarat Board-2020

12. Answer the following :

- (i) n-Butyl bromide has higher boiling point than t-butyl bromide. Why?
- (ii) Arrange the following in increasing order of their rate towards $\text{S}_{\text{N}}1$ reaction $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{Cl}, (\text{CH}_3)_3\text{CH} - \text{Cl}, \text{CH}_2 = \text{CH} - \text{CH}_2 - \text{I}$
- (iii) Write the Finkelstein reaction.

Assam Board-2023

D. Preparation of Haloarenes

Section-A : Multiple Choice Questions

1. $\text{C}_6\text{H}_5\text{N}_2\text{Cl} \xrightarrow[\text{HCl}]{\text{CuCl}} \text{C}_6\text{H}_5\text{Cl}$ is:

- (a) Gattermann's reaction
- (b) Sandmeyer's reaction
- (c) Wurtz's reaction
- (d) Frankland's reaction

MP Board-2014

Ans. (b)

Section-B : Very Short Answer

2. From the type of hybridisation with respect to haloalkanes and haloarenes, predict the reactivity of haloarenes towards nucleophilic substitution in comparison to haloalkanes.
Manipur Board 2020
3. Give the balanced equation, aniline treated with mixture of HNO_2 and excess of HCl at low temperature.
ISC Board-2002
4. Write the chemical equation for the following reaction:
Acetone with sodium hypoiodite.
ISC Board-2005
5. Correct the following statement.
When acetone is treated with bleaching Powder, acetaldehyde is obtained.
ISC Board-2007
6. Explain S_N2 (bi-molecular nucleophilic substitution) reaction with example.
Chhattisgarh Board-2021
7. Why are haloarenes less reactive than haloalkanes towards nucleophilic substitution reaction ?
Nagaland Board-2017

Section-C : Short Answer

1. What are electrophilic substitution reactions? Explain its mechanism with an example of Aryl halide.
UP Board 2019
2. (a) Pick out the odd one from the following on the basis of their medicinal properties : Equanil, Seconal, Bithional, Luminal
(b) What type of detergents are used in dishwashing liquids?
(c) Why is the use of aspartame limited to cold foods?
CBSE-2019
3. Aryl halides are less reactive towards nucleophilic substitution reactions. Write any two reasons for the less reactivity of aryl halides.
Kerala Board-2020
4. Benzene diazonium chloride when treated with Cu_2Cl_2 and HCl , the product formed is chlorobenzene. This reaction is known as _____.
Kerala Board-2020
5. Alkene shows geometrical isomerism but alkyne does not.
Rajasthan Board-2010
6. Define Haloarenes.
J & K board-2023
7. Explain the reasons why aryl halides are less reactive towards nucleophilic substitution reaction.
Nagaland Board-2021

Section-E : Long Answer

1. Differentiate acetaldehyde from benzaldehyde.
Tamilnadu Board, Sep.-2016

E. Properties of Haloarenes

Section-A : Multiple Choice Questions

2. Toluene $\xrightarrow{\text{Cl}_2/\text{hv}}$ A
'A' is
(a) Benzene
(b) Benzaldehyde
(c) Chlorobenzene
(d) None of these

Jharkhand Board-2019

Ans. (a)

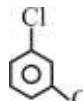
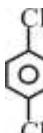
Section-B : Very Short Answer

1. How chlorobenzene is prepared from Benzene Diazonium Chloride? Write chemical reaction only.
Uttarakhand Board 2023
2. Electrophilic reactions in haloarenes occur slowly. Why ?
CBSE-2020
3. Why is $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{Cl}$ more easily hydrolysed than $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$?
CBSE-2019
4. Out of chlorobenzene and benzyl chloride, which one gets easily hydrolysed by aqueous NaOH and why ?
UP Board-2018

Section-C : Short Answer

1. Write chemical equation to prepare diphenyl from chlorobenzene.
Rajasthan Board 2023
2. (a) Identify the chiral molecule in the following pair :

 (i) (ii)
- (b) Write the structure of the product when chlorobenzene is treated with methyl chloride in the presence of sodium metal and dry ether.
(c) Write the structure of the alkene formed by dehydrohalogenation of 1-bromo-1-methylcyclohexane with alcoholic KOH.
UP Board-2018
3. Give reasons for the following :
 (i) Although haloalkanes are polar in nature yet they are immiscible in water.
 (ii) Haloarenes are less reactive than haloalkanes towards nucleophilic substitution reactions.
NIOS Board-2015
4. Although chlorine is an electron withdrawing group, yet it is ortho-para directing in electrophilic aromatic substitution reactions, why ?
Haryana Board-2019

5. Among  and  which has high melting point and why? Haryana Board-2016

6. (a) Write hybridized state of carbon bonded to halogen atom in benzyl chloride. Rajasthan Board-2020

7. Write the structural formulae of benzylic chloride and vinylic chloride. Also give the state of hybridization of the carbon atoms in these two compounds linked to chlorine atoms. Rajasthan Board-2013

8. Give reasons:
 (iii) The presence of nitro group (-NO_2) at o/p positions increases the reactivity of haloarenes towards nucleophilic substitution reactions. Assam Board-2020

9. What happens when bromo-cyclohexane is treated with Mg in presence of dry ether and the product is hydrolysed ? Give chemical equations. Assam Board-2016

10. Why are Haloarenes less reactive than Haloalkane?

MP Board-2013

Section-E : Long Answer

1. Give reasons for the following:

 - Electrophilic substitution in haloarenes occurs slowly.
 - Sulphuric acid is not used during the reaction of alcohols with KI.
 - Alkyl halides give nitrile with KCN and isonitrile with AgCN.

CBSE-2021

2. a) i) Write the equations for the steps in S_N^1 mechanism of the conversion of tertiary butyl bromide in to tertiary butyl alcohol.

CBSE-2021

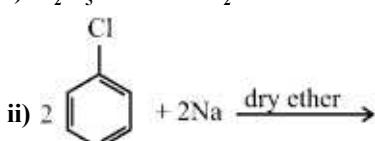
2. a) i) Write the equations for the steps in S_N^1 mechanism of the conversion of tertiary butyl bromide in to tertiary butyl alcohol.

July 2014

ii) Haloarenes are less reactive towards nucleophilic substitution reactions than Haloalkanes. Give a reason,

b) Complete the following equation :

i) $C_6H_5OH + SOCl_2 \longrightarrow$



Karnataka Board-2014

3. On the basis of dipole moment, explain the polar and non-polar properties of 1, 2 dichloroethene.

Rajasthan Board-2010

F. Chemical Reactions

Section-A : Multiple Choice Questions

1. The conversion of an alkyl halide into an alcohol by aqueous NaOH is classified as

 - (a) a dehydrohalogenation reaction
 - (b) a substitution reaction
 - (c) an addition reaction
 - (d) a dehydration reaction

CBSE-2020

Ans. (b)

2. (a) Which of the following is least reactive towards S_N2 reactions ?

(a) CH₃CH₂ – CH₂ – CH₂ – CH₂ – Cl

(b) CH₃ – CH – CH₂ – Cl
 |
 CH₃

(c) CH₃ – CH – CH₂ – CH₃
 |
 Cl
 CH₃

(d) CH₃ – C – Cl
 |
 CH₃

CBSE 2021

Ans. (d)

3. What is the product of reaction between chloroethane and sodium metal in dry ether?

 - (a) Ethane
 - (b) Methane
 - (c) Propane
 - (d) Butane

Gujarat Board-2021

Ans. (d)

Haryana Board-2019

Ans. (b)

5. $\text{CH}_3\text{Br} + 2\text{Na} + \text{CH}_3\text{Br} \xrightarrow{\text{Dry ether}} \text{CH}_3 - \text{CH}_3 + 2\text{NaBr}$

The reaction is

 - Friedel – Crafts reaction
 - Wurtz reaction
 - Fittig reaction
 - None of these

Jharkhand Board-2019

Ans. (b)

6. The reaction is –
(a) Friedel-Crafts reaction
(b) Gattermann-Koch reaction
(c) Rosenmund reduction
(d) None of these

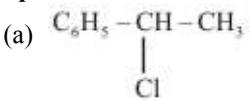
Jharkhand Board-2020

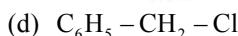
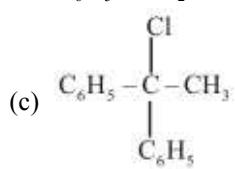
Ans. (a)

7. The reaction of ethylene glycol with PI_3 gives:
 (a) $\text{ICH}_2\text{CH}_2\text{I}$ (b) $\text{CH}_2=\text{CH}_2$
 (c) $\text{CH}_2=\text{CHI}$ (d) $\text{ICH}=\text{CHI}$

Tamilnadu Board, Sep.-2016

Ans. (b)

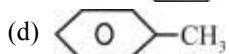
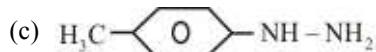
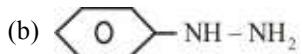
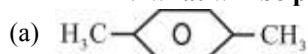
8. Which compound will give unimolecular nucleophilic substitution reaction easily with aqueous NaOH ?
 (a) 



Gujarat Board-2019

Ans. (c)

6. p-Toluenediazonium chloride $\xrightarrow{\text{SnCl}_2+\text{HCl}}$ what will be product of reaction?



Gujarat Board-2019

Ans. (c)

7. Reaction of $\text{C}_6\text{H}_5\text{CH}_2\text{Br}$ with aqueous sodium hydroxide follows ____.

- (a) Nucleophilic (b) $\text{S}_{\text{N}}2$ mechanism
 (c) $\text{S}_{\text{N}}1$ mechanism (d) Saytzeff rule

Gujarat Board-2020

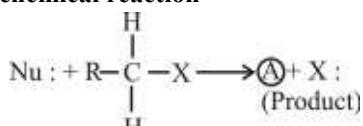
Ans. (c)

Section-B : Very Short Answer

1. A hydrocarbon C_5H_{12} gives only one monochloride on photochemical chlorination. Identify the compound.

CBSE-2020

2. Write down the mechanism of the following chemical reaction-



Uttarakhand Board 2023

3. Out of $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ and $\text{CH}_2=\text{CH}-\text{CH}_2-\text{Cl}$, which one is more reactive towards $\text{S}_{\text{N}}1$ reaction?

CBSE-2020

4. Primary alkyl halide (A), $\text{C}_4\text{H}_9\text{Br}$ reacted with alcoholic KOH to give compound (B). Compound (B) when reacted with HBr gives (C) which is an isomer of (A). When (A) was reacted with sodium metal it gave a compound (D), C_8H_{18} that was different from the compound obtained when n-butyl bromide was reacted with sodium metal. Give the structures of A, B, C and D.

CBSE-2020

5. Why is chlorobenzene less reactive towards nucleophilic substitution? Give two reasons.

CBSE-2021

6. Complete the following reaction and name the reaction.



ISC Board-2007, 2012

7. A precipitate is obtained on adding iodine and sodium hydroxide to

ISC Board-2006, 2008, 2012

8. What is haloform reaction?

Manipur Board-2017

9. Name the organic product formed when chlorobenzene is treated with sodium in dry ether.

Karnataka Board-2015

10. Write the structure of the product formed in the following reactions :



NIOS Board-2013

11. Write chemical equation for a Wurtz reaction.

Haryana Board-2022

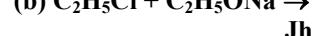
12. Write the reaction of Cl_2 with water.

Haryana Board-2019

13. What is Hoffmann bromamide degradation reaction ?

Haryana Board-2021

14. Complete the following :



Jharkhand Board-2018

15. Name the major product obtained when tertiary butyl bromide is heated with alcoholic KOH solution.

Karnataka Board-2017

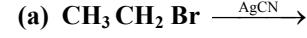
16. Name the major organic product formed when 2-bromopentane is heated with alcoholic potassium hydroxide solution.

Karnataka Board-2019

17. How can it convert methyl iodide to ethanamine ?

Kerala Board-2018

18. Complete the reaction :



Kerala Board-2018

- 19.** During the β - elimination reaction of 2-bromopentane in an alcoholic solution of KOH results Pent - 2- ene as major product and Pent - 1- ene as minor product. State the rule to explain the reaction. **Kerala Board-2018**

20. How will you convert $\text{CH}_3\text{CH}_2\text{Br}$ into following?
 (a) CH_3CH_3
 (b) $\text{C}_2\text{H}_5\text{O-C}_2\text{H}_5$
 (c) $\text{CH}_3\text{CH}_2\text{CN}$ **Haryana Board-2017**

21. Benzyl chloride,  is a primary halide but it undergoes S_N1 reaction as fast as tertiary halides. Give reason. **Manipur Board-2019**

22. Explain the mechanism of Nucleophilic bimolecular substitution (S_N2) reaction with one example. **Andhra Pradesh Board-2021**

23. Write chemical equation of Wurtz reaction. **Rajasthan Board-2020**

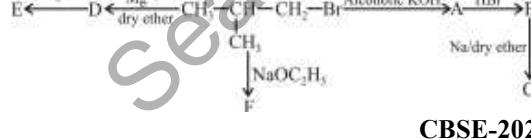
24. Write chemical equation of Wurtz reaction. **Rajasthan Board-2018**

25. Complete the following reactions:
 (a) $\text{CH}_3 - \text{CH} = \text{CH}_2 \xrightarrow{\text{H}^+/\text{H}_2\text{O}} ?$
 (b) $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{CH}_3 + \text{HI} \xrightarrow[\text{(not in excess)}]{} ? + ?$ **Assam Board-2015**

26. What is Wurtz reaction? **Nagaland Board-2018**

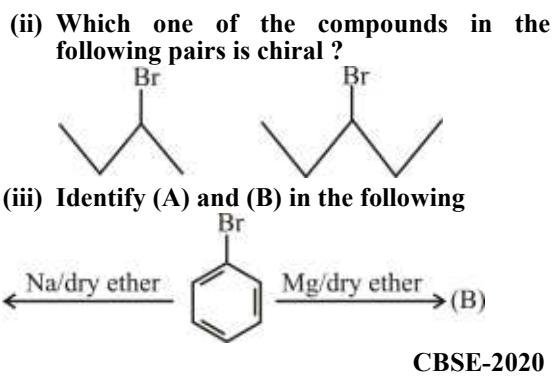
Section-C : Short Answer

1. An alkyl halide (A) of molecular formula $\text{C}_6\text{H}_{13}\text{Cl}$ on treatment with alcoholic KOH gives two isomeric alkenes (B) and (C) of molecular formula C_6H_{12} . Both alkenes on hydrogenation give 2, 3-dimethylbutane. Write the structures of (A), (B) and (C). **Gujarat Board 2023 (July)**

2. Identify A, B, C, D, E and F in the following :


3. (a) Write the mechanism of the following S_N1 reaction :
 $(\text{CH}_3)_3\text{C-Br} \xrightarrow{\text{Aq.NaOH}} (\text{CH}_3)_3\text{C-OH} + \text{NaBr}$
 (b) Write the equation for the preparation of 2-methyl-2-methoxypropane by Williamson synthesis. **CBSE-2020**

4. (i) Write the structure of major alkene formed by β -elimination of 2, 2, 3-trimethyl-3-bromopentane with sodium



5. (a) What happens when
 (i) Bromobenzene is treated with Mg in the presence of dry ether;
 (ii) Chlorobenzene is treated with CH_3Cl in the presence of anhydrous AlCl_3 , and
 (iii) Methyl chloride is treated with AgCN ?
 CBSE-2021

6. Do the following conversions:
 (i) Chloroethane to butane
 (ii) 2-bromopropane to 1-bromopropane.
 (iii) Ethyl chloride to propanoic acid.
 CBSE-2021

7. Explain the following :
 (a) Acylation
 (b) Esterification
 (c) Gattermann-Koch Reaction
 (d) Decarboxylation

Telangana Board-2017

8. (a) Write the chemical reactions for following transformations: (any two)
 (i) Benzyl chloride to benzyl alcohol
 (ii) Methyl magnesium bromide to 2-methylpropan-2-ol
 (iii) Acetophenone from phenol

Assam Board-2022

9. Give the structures of A and B in the following reactions.

(i) $\text{CH}_3\text{CH}_2\text{Br} \xrightarrow{\text{KCN}} \text{A} \xrightarrow[\text{ii)}]{\text{H}_2\text{O}} \text{B}$

(ii) $\text{C}_6\text{H}_5\text{NO}_2 \xrightarrow{\text{Fe/HCl}} \text{A} \xrightarrow[\text{Pyridine}]{(\text{CH}_3\text{CO})_2\text{O}} \text{B}$

Gujarat Board-2021

10. Identify A and B in the following reaction:
 $\text{C}_6\text{H}_5-\text{CH}_2-\text{CHBr}-\text{CH}_3 \xrightarrow[\Delta]{\text{alc. KOH}} \text{A} \xrightarrow{\text{HBr}} \text{B}$

Odisha Board-2017

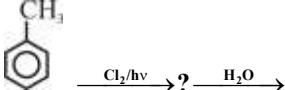
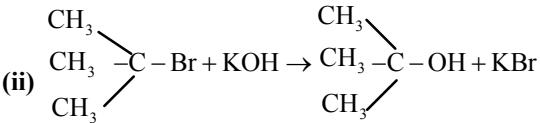
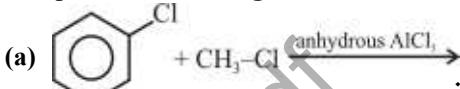
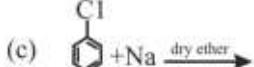
11. Identify A and B in the following reaction:
 $\text{CH}_3\text{Br} \xrightarrow{\text{Mg/ether}} [\text{A}] \xrightarrow[(\text{ii})]{(\text{i}) \text{CO}_2, \text{H}_2\text{O}/\text{H}^+} [\text{B}]$

Odisha Board-2017

12. Write any three reactions to prepared haloalkane from alcohol.

Gujarat Board-2016

13.(a) How can the following conversions be effected?
 (i) Chlorobenzene \rightarrow Aniline
 (ii) Aniline \rightarrow Schiff's base

- (c) Benzene diazonium chloride → Explain with example.
 (d) What is called peptide linkage? Explain with example.
- Tamil Nadu Board-2016
14. Explain mechanism of S_N2 reaction.
- Gujarat Board-2019
15. What happens, when :
 (A) Methyl chloride is treated with aqueous KOH
 (B) Ethyl bromide is treated with Na in presence of dry ether.
 (C) Methyl chloride is treated with KCN.
- Haryana Board-2021
16. Give balanced equation for the following name reactions:
 (i) Friedel-Crafts reaction (alkylation)
- ISC Board-2017
17. (d) Write the mechanism of the following reaction:
 (e) How can you convert benzene to diphenyl?
- Assam Board-2014
18. What is dehydrohalogenation reaction?
 Haryana Board-2017
19. Discuss the Friedel Crafts alkylation reaction.
 Haryana Board-2017
20. What is Wurtz reaction?
 Haryana Board-2017
21. Explain the mechanism of SN^2 reaction.
 Haryana Board-2017
22. Explain the mechanism of S_N2 reaction with one example.
- Andhra Pradesh Board-2018
23. $C_2H_5Br + Mg \xrightarrow{\text{DRY ETHER}} A \xrightarrow{H_2O} B$
 Give the structure of A and B main organic products.
- Haryana Board-2016
24. Give chemical equation for the following reactions:
 (i) Gatterman Reaction
 (ii) Carbylamine reaction
 (iii) Ammonolysis
- Haryana Board-2018
25. How would you differentiate between S_N1 and S_N2 mechanisms of substitution reactions? Give one example of each.
- Haryana Board-2018
26. Complete the following reaction:
- 
- Haryana Board-2018
27. How would you convert the following:
 (i) Propene to propan-2-Ol
 (ii) Benzyl Chloride to Benzyl alcohol.
- Haryana Board-2018
28. Complete the following chemical reactions and write the products.
- (i) $CH_3 - CH_2 - Cl + KOH (\text{Alc.}) \rightarrow$
- (ii) $R - CH = CH_2 + HBr \xrightarrow{\text{Peroxide}}$
- Rajasthan Board-2018
29. (i) $CH_3 - Br + KOH \rightarrow CH_3OH + KBr$.
- (ii) 
- (a) Which types of nucleophilic substitution are in above reaction (i) and (ii).
- Rajasthan Board-2017
30. Complete the following chemical reactions :
- (a) 
- (b) $CH_3 - CH_2 - Cl + KCN \xrightarrow{\Delta} \dots$
- (c) $CH_3 - CH = CH_2 + HI \longrightarrow \dots$
- (d) $CH_3 - CH_2 - OH + NaBr + H_2SO_4 \longrightarrow \dots$
- Rajasthan Board-2015
31. Write an equation of reaction of chlorine with hot and concentrated NaOH solution.
- Rajasthan Board-2015
32. Write an equation of the reaction of chlorine with cold and dilute NaOH solution.
- Rajasthan Board-2015
33. Complete the following reaction and explain its mechanism:
- $(CH_3)_3CBr + OH^- (\text{aq.}) \rightarrow \dots$
- Rajasthan Board-2015
34. Predict the products of the following reactions :
- (a) $CH_3 - CH_2 - Br + AgCN \xrightarrow{(\text{aq. alcohol})} \dots$
- (b) $CH_3 - CH_2 - Br + KNO_2 \xrightarrow{(\text{aq. alcohol})} \dots$
- (c) 
- (d) $CH_3 - I + Mg \xrightarrow{\text{dry ether}} \dots$
- Rajasthan Board-2014
35. Write the equations for the following reactions:
 (a) Wurtz reaction
 (b) Wurtz-fitting reaction
- Rajasthan Board-2013
36. How is benzophenone prepared by Friedel Craft's reaction?
- Tamilnadu Board, March-2016
37. Answer the following:
 (ii) Give the structures of A, B and C in the following reactions:
- $CH_3Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[273K]{HNO_3} C$
- Assam Board-2020
38. Give preparation and uses of D.D.T.
- Gujarat Board-2017

Ans. (b)

40. How will you convert the following (any two)?
Give chemical equations only.

 - (i) Ethane to bromoethene
 - (ii) Benzene to biphenyl
 - (iii) Aniline to chlorobenzene

Assam Board-2019

41. Identify the products A and B in the following reactions:

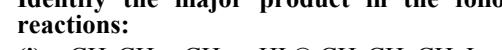
(i)  $\xrightarrow[\text{Cl}/\text{hv}]{} \text{A} \xrightarrow[\text{373 K}]{\text{H}_2\text{O}} \text{B}$

(ii) $\text{HCHO} \xrightarrow[\text{D}]{\text{Conc. KOH}} \text{A} + \text{B}$

Assam Board-2018

42. Identify the major product in the following reactions:

(i) $\text{CH}_3\text{CH} = \text{CH}_2 + \text{HI} \xrightarrow{\text{R}} \text{CH}_3\text{CH}_2\text{CH}_2\text{I}$
 $+ \text{CH}_3\text{CHICH}_3$



(ii)  + $\text{Cl}_2 \xrightarrow{\text{Anhyd. FeCl}_3}$  + 

Assam Board-2018

43. Identify A and B in the following two reactions:

(i)

$$A + \text{Na} + \text{CH}_3\text{Cl} \xrightarrow{\text{ether}} \text{C}_6\text{H}_5\text{CH}_3 + \text{NaCl}$$

(ii)

$$2 \text{C}_6\text{H}_5\text{Cl} + 2\text{Na} \xrightarrow{\text{ether}} B + 2\text{NaCl}$$

Assam Board-2017

44. When HCl reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride. Explain, why? Assam Board-2016

45. Give the formulae of A, B, C and D in the following reactions–

(i) $\text{CH}_3\text{CH}_2 - \text{Cl} \xrightarrow{\text{ethanolic NaCN}} \text{A} \xrightarrow{\text{H}_2/\text{Ni}} \text{B}$

(ii) $\text{C}_6\text{H}_5\text{NO}_2 \xrightarrow{\text{Fe/HCl}} \text{C} \xrightarrow[273-298\text{K}]{\text{NaNO}_2/\text{HCl}} \text{D}$

Assam Board-2015

ISSN 1062-1024

40. (a) Identify A, B, C and D.

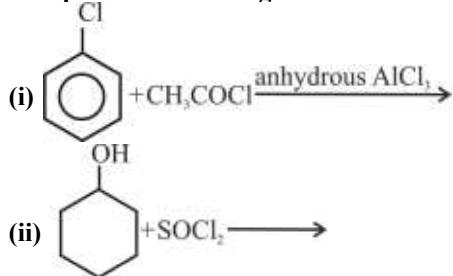
(i) $\text{CH}_3\text{CH}_2\text{Br} \xrightarrow{\text{KCN}} \text{A} \xrightarrow{\text{LiAlH}_4} \text{B}$

(ii) $\text{C}_6\text{H}_5\text{NO}_2 \xrightarrow{\text{Fe+HCl}} \text{C} \xrightarrow[\text{HCl}]{\text{NaNO}_2} \text{D}$

(b) Write one chemical test to distinguish between ethylamine and aniline.

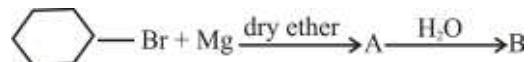
Assam Board-2013

- 47. Complete the following reactions:**



Assam Board-2012

- 48. (a) Identify A and B in the following:**



- (b)** Write the structure of the following compound. 2 - chloro - 3 - methylpentane

Assam Board-2012

- 49.** Write the equation of following reactions of chlorobenzene—
(i) Halogenation (ii) Nitration
(iii) Sulphonation (iv) Alkylation

MP Board-2015

- ### **50. Discuss Wurtz reaction.**

J&K Board-2020

- 51. Answer the following questions :**

(a) How do polar

- (b) Write the structure of the major organic product produced in the following reaction :

$$\text{CH}_3\text{CH}_2\text{I} + \text{AgCN} \xrightarrow[\text{D}]{\text{C}_2\text{H}_5\text{OH}/\text{H}_2\text{O}}$$

anes of molecular

Section-D : Case Based Study

The substitution reaction of alkyl halide mainly occurs by S_N1 or S_N2 mechanism. Whatever mechanism alkyl halides follow for the substitution reaction to occur, the polarity of the carbon halogen bond is responsible for these substitution reactions. The rate of S_N1 reactions are governed by the stability of carbocation whereas for S_N2 reactions steric factor is the deciding factor. If the starting material is a chiral compound, we may end up with an inverted product or racemic mixture depending upon the type of mechanism followed by alkyl halide. Cleavage of ethers with HI is also governed by steric factor and stability of carbocation, which indicates that in organic chemistry, these two major factors help us in deciding the kind of product formed.

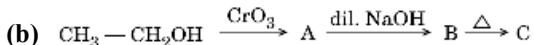
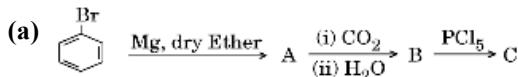
1. Predict the stereochemistry of the product formed if an optically active alkyl halide undergoes substitution reaction by S_N1 mechanism.

CBSE-2020

2. Name the instrument used for measuring the angle by which the plane polarised light is rotated.
CBSE-2020
3. Predict the major product formed when 2-Bromopentane reacts with alcoholic KOH.
CBSE-2020
4. Give one use of CHI_3
CBSE-2020
5. Write the structures of the products formed when anisole is treated with HI.
CBSE-2020
6. (b) An element 'A' belongs to group number 11 and period number 5 and is a lustrous white metal. 'A' reacts with dil. HNO_3 to give 'B'. 'B' is called as Lunar caustic 'B' reacts with KI gives 'C' which bright yellow colored precipitate. Identify 'A', 'B' and 'C' Explain the reactions.
Tamil Nadu Board-2015

Section-E : Long Answer

1. (a) (i) Identify A, B and C in the following reactions:

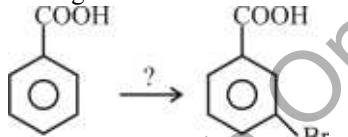


- (ii) By what test will you distinguish between:
 (I) Ethanol and Benzaldehyde
 (II) Acetone and Acetic acid

CBSE-2021

2. Do as directed:

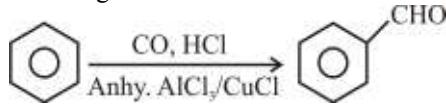
- (a) Write the reagent used to bring about the following conversion:



- (b) Write labelled chemical equation to show, what happens when Benzoyl chloride is hydrogenated in the presence of palladium and barium sulphate.

- (c) Arrange the following compounds in the increasing order of their acidic strength:
 CCl_3COOH , $\text{NC}-\text{CH}_2\text{COOH}$, CF_3COOH , $\text{NO}_2\text{CH}_2\text{COOH}$.

- (d) State the name of the reaction in the following conversion:



Goa Board-2023

3. Giving one example for each, explain the following rules.

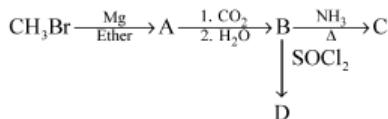
- (a) Huckel Rule
 (b) Markownikoff's Rule
 (c) Saytzeff's Rule

NIOS Board-2018

4. (a) What are free radicals? How are they formed?
 (b) Explain the following with example:
 (i) Nucleophilic substitution reaction
 (ii) Functional isomerism

NIOS Board-2019

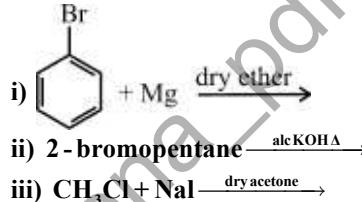
5. (a) Write names and structures of A, B, C and D in the following sequence reactions:



- (b) Identify the groups with $-I$ and $+I$ effects from the following species:
 $-\text{NO}_2$, $-\text{C}_2\text{H}_5$, $-\text{C}_6\text{H}_5$ and $(\text{CH}_3)_3\text{C}-$

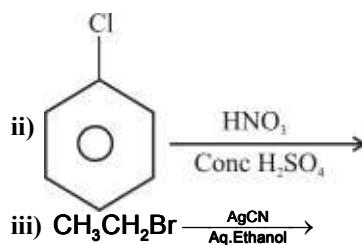
NIOS Board-2023

6. a) Mention the major product formed in the following reaction:



Karnataka Board-2014

7. a) Explain S_N1 mechanism for the conversion of tertiary butyl bromide to tertiary butyl alcohol.
 b) Complete the following reactions:



Karnataka Board-2020

8. a) How does benzene reacts with acetylchloride in the presence of anhydrous AlCl_3 . Give equation.
 b) i) Write general equation for etherification reaction.
 ii) Name the product obtained when benzoic acid is heated with ammonia.
 c) Name the reagent used in the Clemmensen reduction.

Karnataka Board-2019

- a) Write the equations for the steps involved in the S_N1 mechanism of hydrolysis of 2-bromo2-methyl propane.
 b) i) Name the product formed for the reaction of isopropyl iodide on alcoholic KOH.
 ii) What is the condition to be satisfied for a compound to be chiral?
 c) What is racemic mixtures?

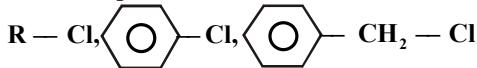
Karnataka Board-2019

10. a) Write the equations for the steps in S_N1 mechanism of the conversion of tert-Butyl bromide into tert-Butyl alcohol.
 b) Explain Fitting reaction.
 c) Name the reagent used in the dehydrohalogenation of haloalkanes.
- Karnataka Board-2018
11. a) Write S_N2 mechanism for the conversion of methyl chloride to methyl alcohol.
 b) Aryl halides are extremely less reactive towards nucleophilic substitution reactions. Give any two reasons.
 c) What is asymmetric carbon?
- Karnataka Board-2017
12. How does diethylether react with the following reagents?
 (i) H^+/H_2O
 (ii) PCl_5
- Tamil Nadu Board-2016
13. (i) Hydrogen atom of chloroform is acidic. Explain.
 (ii) Why is dehydrohalogenation reaction in haloalkanes termed as Beta-elimination reaction ?
- Punjab Board-2017
15. Explain the following reactions:
 (i) Wolff-Kishner Reduction
 (ii) Friedal-Crafts Acylation
- NIOS Board-2023
16. a) i) Explain the S_N2 mechanism
 ii) What is the reagent used in the conversion of alkyl halide into alkene?
 b) Complete the reaction
 $CH_3 - CH_2 - Br + AgCN \xrightarrow{\Delta} \dots$
 c) What are enantiomers?
- Karnataka Board-2015
17. a) i) Explain S_N2 mechanism taking an example of chloromethane.
 ii) Write the general equation for the reaction of primary alcohol with $SOCl_2$.
 b) i) $CH_3 - Br + AgF \rightarrow CH_3F + AgBr$. Name the reaction.
 ii) P-dichlorobenzene has higher melting point than those of ortho and meta isomers. Give reason. (3 + 2)
- Karnataka Board-2016
18. a) Explain the mechanism of S_N1 reaction taking 2-bromo-2methyl propane (t-butyl bromide)
 b) Aryl halides are extremely less reactive towards nucleophilic substitution reactions. Give any two reasons.
- Karnataka Board-2017
19. a) Write the equations for the steps in S_N1 mechanism of the conversion of tert-Butyl bromide into tert-Butyl alcohol.
 b) Explain Wurtz-Fittig reaction with equation
 c) $CH_3Cl + NaI \rightarrow CH_3I + NaCl$
- Karnataka Board-2018
20. (a) Complete the following reaction:
 $CH_3OH \xrightarrow{H^+} A \xrightarrow{KCN} B \xrightarrow{[H]} C$
 $D \xleftarrow{HNO_2}$
- (b) How do you account for the miscibility of Ethoxyethane in water?
 (c) Among HI & HBr which is a better reagent for cleavage of ether?
- Haryana Board-2016
21. Haloalkanes and haloarenes are compounds containing halogen atom. They undergo many types of reactions.
 (a) Identify the product formed in the following reaction:
 $CH_3 - CH_2 - CH_2Cl \xrightarrow{alc KOH} \dots$
 (i) $CH_3 - CH_2 - CH_2 - OH$
 (ii) $CH_3 - CH - CH_3$
 $\quad |$
 $\quad OH$
 (iii) $CH_3CH = CH_2$
 (iv) $CH_3C = CH_2$
- (b) (i) Chloroform is stored in closed, dark coloured bottles completely filled up to the neck. Give reason.
 (ii) Write any two differences between S_N1 and S_N2 reactions.
- Kerala Board-2016
22. Discuss Swarts reaction.
- Haryana Board-2016
23. Either
 (a) Compound A (mol. formula, C_4H_8) is an unsymmetrical alkene. On treatment with HBr , A forms a tertiary bromide, B. Identify A, B and write the mechanism of the hydrolysis reaction of B with aqueous KOH.
 (b) Methylbromide, CH_3Br can be prepared by treating methanol with HBr but not with $NaBr$. Explain why.
- Manipur Board-2022
24. (c) An aromatic hydrocarbon (C_6H_6) undergoes electrophilic monosubstitution with Br_2/Fe to give compound A. On treatment with concentrated nitric acid in the presence of concentrated sulphuric acid compound A is converted to compound B as major product. Identify A, B and write the mechanism of the conversion reaction of A to B.
 (d) Benzyl chloride is more reactive than its isomeric form 1-chloro-4-methylbenzene towards hydrolysis reaction. Give reason.
- Manipur Board-2022
25. (a) Write chemical equation of Finkelstein reaction.
 (b) Why aryl halides are less reactive towards nucleophilic substitution reactions?
 (c) Arrange the following alkyl halides in increasing order of their reactivity towards S_N2 reaction
 $CH_3 - CH_2 - Cl, (CH_3)_2CH - Cl, (CH_3)_3C - Cl$
 (d) Draw the orbital diagram of CH_3Cl .
- Rajasthan Board-2019

26.(a) Write chemical equation of Wurtz-Fittig reaction.

(b) The reaction of alkyl chloride with aqueous KOH leads to the formation of alcohols but in presence of alcoholic KOH, alkenes are major products. Explain.

(c) Arrange the following halogen derivatives in increasing order of their reactivity towards nucleophilic substitution reactions.



(d) Draw a labelled diagram of laboratory method of preparation of chloroform.

Rajasthan Board-2019

27. Write the chemical equation of following reaction.

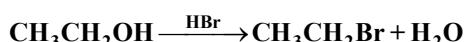
(i) Swarts reaction.

(ii) Sandmeyers reaction.

Rajasthan Board-2017

28. Answer the following:

(i) Write the mechanism of the following reaction:



Assam Board-2020

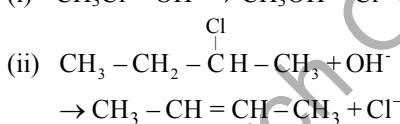
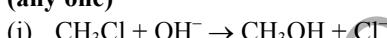
29. Give any one reaction of Swartz, Wurtz and Finkelstein reaction of alkyl halides.

Gujarat Board-2018

30. Explain reaction mechanism with figure of reaction of tertiary butyl chloride with aqueous NaOH.

Gujarat Board-2018

31. Write mechanism of the following reaction: (any one)



Assam Board-2018

32. What happens when (Write equation only)

(i) Ethyl bromide reacts with silver nitrite solution.

(ii) Methyl bromide reacts with sodium metal in presence of dry ether.

(iii) Ethyl bromide reacts with sodium ethoxide.

(iv) Ethyl bromide reacts with magnesium metal.

MP Board-2015

33. Explain the following reactions of Chlorobenzene:

(a) Reaction with chlorine in the presence of FeCl_3 in dark

(b) Fitting reaction.

MP Board-2012

G. Polyhalogen Compounds

Section-A : Multiple Choice Questions

1. By which reaction Freon 12 is prepared from CCl_4 ?

- (a) Finkelstein reaction (b) Fitting reaction
(c) Wurtz reaction (d) Swarts reaction

Gujarat Board 2023 (March)

Ans. (d)

2. Which compound was used as fire extinguisher?

- (a) CHCl_3 (b) CCl_4
(c) CH_2Cl_2 (d) CH_3Cl

Gujarat Board-2022 (July)

Ans. (b)

3. $\text{CH}_3\text{Br} + \text{AgF} \rightarrow$ Product

What is the name of this reaction?
(a) Finkelstein (b) Wurtz
(c) Grignard (d) Swarts

Gujarat Board-2022 (July)

Ans. (d)

4. Which of the following reacts with water?

- (a) CHCl_3 (b) $\text{Cl}_3\text{C}-\text{CHO}$
(c) CCl_4 (d) $\text{ClCH}_2\text{CH}_2\text{Cl}$

Haryana Board-2017

Ans. (b)

5. By which name CCl_4 is used in fire-extinguisher?

- (a) Chloroform (b) phosphene
(c) Phosgene (d) Pyrene

Gujarat Board-2016

Ans. (d)

6. CCl_2F_2 is known as ____.

- (a) Freon-122 (b) Freon-12
(c) Freon-21 (d) Freon-22

Gujarat Board-2016

Ans. (b)

7. How many σ and π bonds are present in the structure of DDT respectively?

- (a) 17, 6 (b) 20, 6
(c) 21, 6 (d) 29, 6

Gujarat Board-2018

Ans. (d) :

8. Which substance is used to extinguish fire in substances like oil, fat and petrol?

- (a) CHCl_3 (b) CH_2Cl_2
(c) CH_3Cl (d) CCl_4

Gujarat Board-2018

Ans. (d) :

9. Which compound is used as fire extinguisher?

- (a) CH_2Cl_2 (b) CCl_4
(c) CHCl_3 (d) DDT

Gujarat Board-2018

Ans. (b)

10. Which substance is added in chloroform before the use of it as anesthetic?
- Acetone
 - Ethyl alcohol
 - Methyl Ethyl ketone
 - Methylene chloride

Gujarat Board-2019

Ans. (b)

11. Which of the following substance does not produce Triiodomethane with the mixture of alkali and I_2 ?
- Propan-1-ol
 - Dimethyl ketone
 - Ethanol
 - Ethanal

Gujarat Board-2019

Ans. (a)

12. Which compound is used as fire extinguisher?
- | | |
|----------------------|------------------------|
| (a) Dichloromethane | (b) Tri lodomethane |
| (c) Trichloromethane | (d) Tetrachloromethane |

Gujarat Board-2020

Ans : (d)

Section-B : Very Short Answer

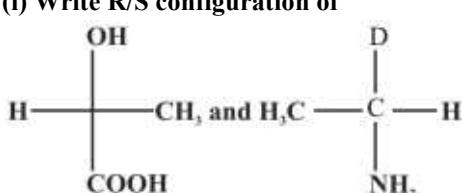
1. Chloroform is stored in closed dark coloured bottles
- Gujarat Board 2023 (July)
2. Name the poisonous gas evolved when chloroform is oxidised by air in the presence of light.

Karnataka board 2023

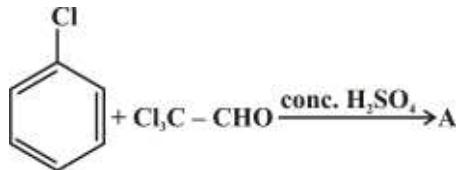
3. Mention one use of tetrachloromethane.
- Assam Board-2015

Section-C : Short Answer

1. Write short notes on :
- Freon
 - D.D.T.
 - Tetrachloromethane
- Haryana Board 2023
2. What are interhalogen compounds ? Give the structures of any two interhalogen compounds.
- Chhattisgarh Board-2023
3. Write the possible isomers of dichlorobenzene and their dipole moment order.
- Tamil Nadu Board-2016
4. (i) Write R/S configuration of



- (ii) Write structural formula of 'A' for the following reaction :



- (iii) Distinguish between propnone and pentan - 3 - one by a suitable chemical test.

West Bengal Board-2019

5. Aryl halides are less reactive in nucleophilic substitution reactions.

- Write any two reasons for less reactivity .
- Give one example for nucleophilic substitution reactions of aryl halides.

Kerala Board-2016

6. Write a method for the preparation of alkyl halides.

Kerala Board-2016

7. Which of the following is not polyhalogen compound.

Kerala Board-2016

10. Explain the following reactions of chloroform:
- Effect of Air and Sunlight
 - Reimer-Tiemann Reaction.

MP Board-2012

11. What are interhalogen compounds ? How are they classified ?

J&K Board-2020

Section-E : Long Answer

1. (a) State Saytzeff's rule with example.
(b) Which is more reactive towards nucleophilic substitution reaction? Haloalkenes or Haloarenes. Give reason for your answer.

NIOS Board-2023

2. What are interhalogen compounds? Give a method of preparation of any one interhalogen compound.

Assam Board-2016

3. Explain the following reactions of chloroform:
- Effect of Air and Sunlight
 - Reimer-Tiemann Reaction

MP Board-2018

4. Explain the following reactions of chlorobenzene:
- Reaction with chlorine in the presence of $FeCl_3$ in dark
 - Fitting reaction.

MP Board-2018

11.

Alcohols, Phenols and Ethers

A. Nomenclature

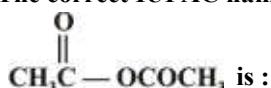
Section-A : Multiple Choice Questions

1. Isomerism exhibited by ethylene glycol is:
- Position isomerism
 - Chain isomerism
 - Functional isomerism
 - Both (a) and (c)

Tamil Nadu Board-2015

Ans. (d)

2. The correct IUPAC name of is :



- Methyl ethanoate
- Aceto ethanoate
- Ethanoic anhydride
- Ethanol ethanoate

NIOS Board-2021

Ans. (c)

3. IUPAC name of 1,4 – Benzoquinone is–

- quinols
- cyclohexa – 1,4 – diene – 3, 6 - dione
- 1, 4 - benzoquinone
- cyclohexa – 2,5 – diene – 1,4 - dione

Gujarat Board-2019

Ans. (d)

4. The IUPAC name of the main organic product obtained by oxidation of phenol is _____

- cyclo hexa-2,5 diene-1,4-diol
- cyclo hexa-2,5 diene-1,4-dione
- cyclo hexa-1,4 diol
- cyclo hexa-1,4 dione

Gujarat Board-2016

Ans.(b)

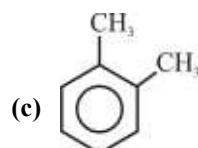
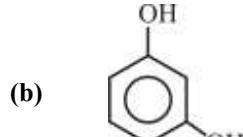
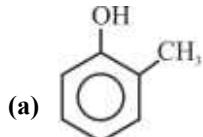
5. What is the order of a reaction if the half life period of the reaction becomes half by doubling the initial concentration of the reactant?

- 0
- 1
- 2
- 0.5

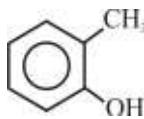
Gujarat Board-2016

Ans.(c)

6. Which is the structural formula of O-cresol?



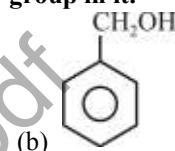
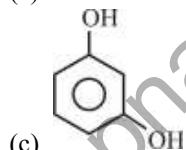
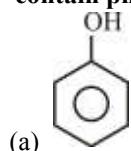
(d)



Gujarat Board-2017

Ans.(a)

7. Which of the following compound does not contain phenolic "–OH" group in it.



Gujarat Board-2020

Ans. (b)

8. The functional group in alcohols is:

- | | |
|----------|----------|
| (a) —O— | (b) —OH— |
| (c) >C=O | (d) —CHO |

J & K board-2023

Ans. (b)

9. What is the IUPAC name of $\text{CH}_3 - \text{O} - \text{C}_2\text{H}_5$?

- Methoxymethane
- Ethoxyethane
- Methoxyethane
- 2-methoxyethane

Jharkhand Board-2023

Ans. (c)

Section-B : Very Short Answer

1. Write I.U.P.A.C. name of $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2\text{CH}_3$.

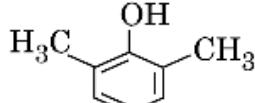
UP Board 2023

2. Write IUPAC name of isobutyl alcohol.

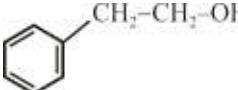
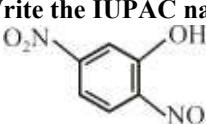
Rajasthan Board 2023

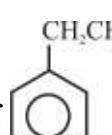
3. (a) Show the chemical reaction with bond movements and arrows for the nucleophilic attack of water on carbocation in acid catalysed hydration of alkenes.

- (b) Give IUPAC name for the following :



CBSE-2019

4. Write the names and structures of three isomers which have the same molecular formula C_3H_8O .
ISC Board-2008
5. Write the structure of the following compound 2-methyl-2-ethoxypentane.
Delhi 2009C
6. Write the IUPAC name of
 $\begin{array}{c} CH_3 - O - CH_2 - CH - CH_2 - CH_3 \\ | \\ CH_3 \end{array}$
All India 2008
7. Write the IUPAC name of the following compound.
 $\begin{array}{c} CH_3 \\ | \\ CH_3 - O - C - CH_3 \\ | \\ CH_3 \end{array}$
All India 2017
8. Write the IUPAC name of the given compound:
 $CH_3 - CH - CH_2 - O - CH_2 - CH_3$
CH₃
All India 2015
9. Write the structure of the molecule of compound whose IUPAC name is 1-phenylpropan-2-ol.
All India 2010
10. Give IUPAC name of the following compound:
 $H_2C = CH - CH - CH_2 - CH_2 - CH_3$
OH
All India 2009
11. Write the IUPAC name of
 $H_3C - CH - CH_2 - CH - CH - CH_2OH$
CH₃ OH CH₃
Delhi 2008
12. Draw the structure of 2,6-dimethylphenol.
All India 2011
13. Draw the structure of hex-1-en-3-ol compound.
Delhi 2012
14. Draw the structural formula of 2-methylpropan-2-ol molecule.
Delhi 2012
15. Write the IUPAC name of the following compound:
 $CH_3 - CH = CH - CH - CH_2 - CH_3$
OH
Foreign 2012
16. Write IUPAC name of the following compound.
 $HO - CH_2 - CH - CH_2 - OH$
OH
Foreign 2014
17. Write the IUPAC name of the following compound.
 $H_3C - C = C - CH_2 - OH$
CH₃ Br
All India 2017
18. Write IUPAC name of the given compound:

All India 2016
19. Write the IUPAC name of the given compound.

Delhi 2015
20. Write the IUPAC name of the given compound:
 $HO - CH_2 - CH = C - CH_3$
CH₃
Foreign 2015
21. Write the IUPAC name of the following compound:

Assam Board-2022
22. Write the IUPAC name of the following:
 CH_3
|
 $CH_3 - C - CH - CH_3$
|
 $C_2H_5 OH$
UP Board-2018
23. Write down an isomer of C_2H_5OH
Punjab Board-2017
24. Identify the type of isomerism exhibited by the following compounds:
(a) $CH_3CH_2CH_2C(OH)HCH_3$ &
 $CH_3CH_2C(OH)HCH_2$
(b) $CH_3 - C = C - C_2H_5$ and $CH_3 - C = C - H - C_2H_5$
(c) $CH_3CH_2CH_2OH$ & $CH_3CH_2 - O - CH_3$
(d) $CH_3 - O - CH_2CH_2CH_3$
& $CH_3CH_2 - O - CH_2CH_3$
NIOS Board-2023
25. IUPAC name of  is
Haryana Board-2022

8. Propene on oxidation with diborane in presence of alkaline hydrogen peroxide gives -
 (a) propan-1-ol
 (b) propan-2-ol
 (c) allyl alcohol
 (d) propan-1,2-diol

Maharashtra board-2018

Ans. (a)

9. Alkyl halides are prepared from alcohol by treating with:

- (a) HCl + ZnCl₂ (b) H₂SO₄ + KI
 (c) NaCl + H₂SO₄ (d) None of the above

Haryana Board-2017

Ans. (a)

10. RCOOH $\xrightarrow{\text{LiAlH}_4 / \text{Either}}$ A, A is:

- (a) RCH₂OH (b) RCH₃
 (c) RCHO (d) ROR

Haryana Board-2016

Ans. (a)

11. CO + 2H₂ $\xrightarrow{\text{X}}$ CH₃OH which is catalyst X here?

- (a) Cu/ZnO-Cr₂O₃ (b) Cu
 (c) Ni (d) Ni-ZnO

Gujarat Board-2018

Ans. (a)

12. What is the proportion of sigma (σ) and pi (π) bond in 1,4-Benzoquinone?

- (a) 1 : 3 (b) 3 : 2
 (c) 3 : 1 (d) 2 : 3

Gujarat Board-2018

Ans. (c)

13. 2,3-Dimethylbut-2-en $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ which final product is obtained in this reaction?

- (a) Propanal, Propanone
 (b) Propanone
 (c) Propanal, Ethanal
 (d) Propanal, Propanol

Gujarat Board-2019

Ans. (b)

14. Hydration of propene in the presence of dil. H₂SO₄ gives

- (a) CH₃-CH₂-CH₂-OH
 (b) CH₃-CH(OH)-CH₃
 (c) CH₃-CH₂-OH
 (d) CH₃-OH

Jharkhand Board-2023

Ans. (b)

Section-B : Very Short Answer

1. (i) What happens when phenol reacts with
 (1) Conc. HNO₃ and
 (2) CHCl₃ in presence of aqueous NaOH followed by acidification?
 Write equations only

Gujarat Board 2023 (July)

2. (i) Write hydroboration-oxidation reaction with an example.
 (ii) Write the products of the following reaction:

Gujarat Board 2023 (July)

3. Account for the following:
 (b) (±)-Butane-2-ol is optically inactive, though it contains a chiral carbon atom.

Gujarat Board 2023 (July)

4. Explain with example Kolbe's reaction.

Haryana Board 2023

5. Why Phenol is more Acidic than Alcohol?

Haryana Board 2023

6. How is phenol manufactured industrially? Write the chemical equation.

Kerala Board 2023

7. How is phenol manufactured by Curnow process?

Karnataka board 2023

8. Explain Kolbe's reaction with equation.

Karnataka board 2023

9. Complete the following reaction:

- (i) Chlorobenzene to phenol

- (ii) Diethyl ether to ethanol

ISC Board-2015

10. How will you convert phenol to picric acid? Write the relevant equation.

ISC Board-2003

11. Give one chemical test to distinguish between the following pairs of compounds: Acetone and phenol

ISC Board-2013

12. How can you convert benzene to phenol?

ISC Board-2012

13. How will you bring about the following conversion?

- Phenol to benzoic acid

ISC Board-2009

14. Give one test to distinguish between phenol and benzoic acid.

ISC Board-2004

15. How will you convert phenol to salicylic acid?

ISC Board-2004

16. Give reason why phenol is more easily nitrated than benzene?

ISC Board-2001

17. Give balanced equation and explain what happens when phenol is treated with bromine water

ISC Board-2000

18. Give the balanced equation for the following name reaction:
Reimer-Tiemann reaction
ISC Board-2015
19. How will you convert acetaldehyde to isopropyl alcohol?
ISC Board-2000, 2002
20. How can the following conversions be brought about:
Acetaldehyde to propan-2-ol
ISC Board-2017
21. How are the following conversions carried out
(i) Propene to propan -2-ol?
(ii) Ethyl magnesium chloride to propan-1-ol?
Delhi 2010
22. Write the mechanism of hydration of ethene to ethanol.
Foreign 2010, 2009
23. How will you convert
(i) propene to propan-1-ol?
(ii) ethanal to propan-2-ol?
Delhi 2013
24. How will you convert
(i) propene to propan-2-ol?
(ii) phenol to 2, 4, 6- trinitrophenol?
Delhi 2013
25. Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol.
All India 2012
26. How are the following conversions carried out?
(i) Propene to propan-2-ol?
(ii) Ethyl chloride to ethanal?
Delhi 2014C
27. Write the chemical equation for the preparation of phenol from benzene using oleum and sodium hydroxide.
Delhi 2011
28. How is phenol prepared from Aniline? Write the equation.
Karnataka Board-2020
29. What happens when formaldehyde reacted with conc. KOH solution?
Haryana Board-2022
30. What is Denatured alcohol?
Haryana Board-2022
31. Give a method with reactions by which all the three types of alcohol can be prepared
J&K Board-2019
32. Give a reagent which is used to distinguish 1°, 2° and 3° alcohols.
Kerala Board-2022
33. Identify the product formed when phenyl magnesium bromide undergoes hydrolysis.
Manipur Board-2022
34. Give a method of preparation of 3° alcohol.
Assam Board-2018
35. Write one general method for the preparation of the following class of compounds with necessary chemical equations:
(a) Primary alcohol
(b) Phenol
(c) Ether
Assam Board-2012

Section-C : Short Answer

1. Write two methods of preparation of Phenol. How does it react with the following?
(i) Conc. HNO_3
(ii) Br_2 water
(iii) Zinc.
UP Board 2019
2. Write two general methods of preparation of primary alcohol. How will you obtain ethane and ethoxy ethane from ethanol ? Also write two main uses of ethanol. Give equations of all the related reactions.
UP Board 2019
3. Do the following conversions is not more than two steps:
(i) benzaldehyde to 1-phenylethanol
Gujarat Board 2023 (July)
4. Give the major product and write plausible mechanism of the following reaction:

$$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{CH}-\text{CH}_3 \\ | \quad \quad | \\ \text{CH} \quad \text{CH}_3 \end{array} \xrightarrow[\text{180}^\circ\text{C}]{\text{Cone. H}_2\text{SO}_4} \text{Product}$$

Manipur Board 2023
5. In the given reaction, identify the product A, write the IUPAC name and comment on its molecular chirality

Manipur Board 2023
6. Propan-1-ol from Ethyl Magnesium bromide.
UP Board 2023
7. (i) Describe the mechanism of hydration of ethane to yield ethanol.
(ii) Write Kolbe's reaction with an example.
All India 2011C
8. How are the following conversions carried out.
(i) Propene → Propan-2-ol?
(ii) Ethyl magnesium chloride → Propan-1-ol?
(iii) Benzyl chloride → Benzyl alcohol?
All India 2014C
9. How are the following conversions carried out
(i) Benzyl chloride to benzyl alcohol?
(ii) Ethyl magnesium chloride to propan-1-ol?
(iii) Propene to propan -2-ol?
All India 2015
10. (a) Write the chemical reactions for following transformations: (any two)
(i) Benzene to Phenol
(ii) Toluene to Benzyl alcohol
(iii) Benzene to Diphenyl
(b) Why aryl halide undergoes electrophilic substitution reaction rather than nucleophilic substitution reaction?

Assam Board-2022

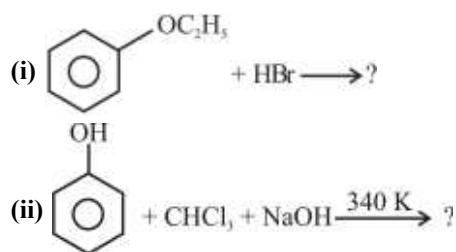
11. What is aspirin? How is it prepared?
Tamil Nadu Board-2011
12. What is Malachite green? How is it prepared?
Tamil Nadu Board-2018
13. (i) Phenol has higher boiling point than toluene. Why?
(ii) Why alcohols are easily protonated but phenols are not protonated?
Punjab Board-2017
14. Write the Mechanism of hydration of ethene to yield ethanol.
Haryana Board-2021
15. Convert:
(i) Propane into Propan-2-ol
(ii) Anisole into Phenol
(Write the reactions only)
Haryana Board-2016
16. Give chemical equation to obtain primary alcohol from Grignard reagent.
Rajasthan Board-2017
17. Write the equations for the following preparations:
(a) Ethyl alcohol from diethyl ether.
Assam Board-2020
18. How do you convert the following?
(i) Benzene to phenol
(ii) Nitromethane to dimethylamine
(iii) Aniline to phenylisocyanide.
Assam Board-2020
19. Write the reaction mechanism of dehydration of ethanol in presence of acid to form ethene.
Gujarat Board-2020
20. A Grignard reagent reacts with methanol to form

$$\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{OH}$$

Identify the Grignard reagent.
Assam Board-2019
21. State the mechanism of the reaction.

$$\text{CH}_3\text{CH} = \text{CH}_2 + \text{H}_2\text{O} \xrightleftharpoons{\text{H}^+} \text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_3$$

Assam Board-2018
22. Give one general method of preparation of 3° alcohol. Give equation.
Assam Board-2017
23. Discuss the nutrition of phenol with conc. HNO_3 in presence of conc. H_2SO_4 .
J & K board-2023
24. What are alcohols ? Give any two methods of preparation of alcohols.
J&K Board-2020
23. How would you convert propene to propan - 1 - ol?
Meghalaya Board-2019
24. Complete the following reactions :



Meghalaya Board-2019

Section-E : Long Answer

1. a) How is phenol manufactured by Cumene process?
b) Among alcohols and phenols which one is more acidic?
And why?
Karnataka Board-2016
2. a) i) Explain the preparation of phenol from cumene.
ii) Complete the reaction

b) Example Williamson ether synthesis. $3 + 2$
Karnataka Board-2014
3. (a) Grignard reagents are important class of organometallic compounds used to prepare alcohols. Identify the compounds A and B and Write the formula.
(a) $\text{HCHO} + \text{CH}_3\text{MgBr} \xrightarrow[(2)\text{H}_2\text{O}]{(1)\text{Dry ether}} \text{A} + \text{Mg(OH)}\text{Br}$
(b) $\text{B} + \text{CH}_3\text{MgBr} \xrightarrow[(2)\text{H}_2\text{O}]{(1)\text{Dry ether}} \text{CH}_3 - \underset{\text{CH}_3}{\text{C}}\text{H} - \text{OH} + \text{Mg(OH)}\text{Br}$
- (b) Write the name of products formed when salicylic acid is treated with acetic anhydride in acid medium.
Kerala Board-2018
4. (a) A mixture of anhydrous ZnCl_2 and conc. HCl is an important reagent used to distinguish primary, secondary and tertiary alcohols. How the above reagent is used to distinguish the three types of alcohols?
(b) Predict the product formed in the reaction

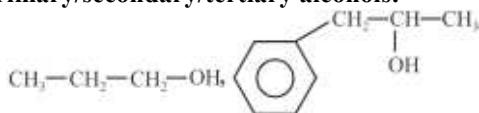
$$\text{CH}_3 - \text{CH}_2 - \text{OH} \xrightarrow[443\text{K}]{\text{Conc. H}_2\text{SO}_4} ?$$

Kerala Board-2020
5. Write only chemical reaction for the preparation of following compounds from phenol.
(a) Phenyl acetate
(b) Benzene
(c) P-Bromophenol
(d) 1,4-Benzoquinone
Gujarat Board-2019

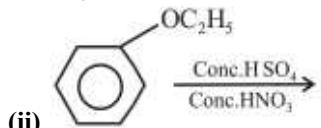
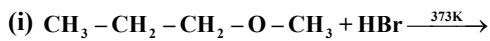
6. Give the chemical reactions of ethyl alcohol with:
 (i) Conc. H_2SO_4 at 440K
 (ii) CH_3COOH
 (iii) CH_3MgBr

J & K Board-2021

7. (a) Classify the following as primary/secondary/tertiary alcohols:



- (b) Predict the products of the following reactions:



Meghalaya Board-2021

C. Reaction of Alcohol and Phenol

Section-A : Multiple Choice Questions

1. $\text{CH}_3 - \underset{\text{CH}_3}{\underset{|}{\text{C}}} - \text{OH} \xrightarrow[\text{573K}]{\text{Cu}} \text{x}$, here what will be x product?
 (a) 2-methyl propane-1-ol
 (b) propene
 (c) 2-methyl propene
 (d) propane-1-ol

Gujarat Board-2022 (July)

Ans. (c)

2. Which of the following is correct for orthorhombic crystal system.
 (a) $a = b = c$ (b) $a = b \neq c$
 (c) $a \neq b \neq c$ (d) $a \neq b = c$

Gujarat Board-2022 (July)

Ans. (c)

3. In reaction of manufacture of phenol from cumene the by-product is
 (a) Tribromophenol (b) Benzoquinone
 (c) Picric acid (d) Acetone

Rajasthan Board 2023

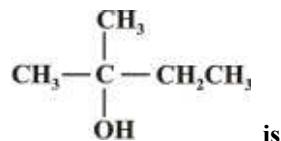
Ans. (d)

4. Assertion (A) : Phenol is more acidic than p-methylphenol.
 Reason (R) : The presence of an electron releasing group in p-methylphenol makes it less acidic.
 (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

- (b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
 (d) Assertion (A) is incorrect, but Reason (R) is correct statement.

CBSE-2020

5. The correct IUPAC name of



is

- (a) tert-butyl alcohol
 (b) 2,2-Dimethylpropanol
 (c) 2-Methylbutan-2-ol
 (d) 3-Methylbutan-3-ol

CBSE-2020

6. Assertion (A): o-nitrophenol is a weaker acid than p-nitrophenol.
 Reason (R): Intramolecular hydrogen bonding makes ortho isomer weaker than para isomer.
 (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
 (d) Assertion (A) is incorrect, but Reason (R) is correct statement.

CBSE-2020

7. Which of the following reactions will be the fastest under identical conditions?
 (a) $\text{C}_2\text{H}_5\text{OH} + \text{HI} \longrightarrow \text{C}_2\text{H}_5\text{I} + \text{H}_2\text{O}$
 (b) $\text{C}_2\text{H}_5\text{OH} + \text{HCl} \longrightarrow \text{C}_2\text{H}_5\text{Cl} + \text{H}_2\text{O}$
 (c) $\text{C}_2\text{H}_5\text{OH} + \text{HBr} \longrightarrow \text{C}_2\text{H}_5\text{Br} + \text{H}_2\text{O}$
 (d) $\text{C}_2\text{H}_5\text{OH} + \text{HF} \longrightarrow \text{C}_2\text{H}_5\text{F} + \text{H}_2\text{O}$

CBSE-2021

Ans. (a)

8. What is the product of Riemer-Tiemann reaction?
 (a) Salicylaldehyde (b) Salicylic acid
 (c) Benzoquinone (d) Picric acid

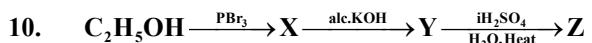
Gujarat Board-2021

Ans. (a)

9. $\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OH} \xrightarrow{\text{PCC}} \text{'A' 'A' is}$
 (a) $\text{CH}_3(\text{CH}_2)_4\text{COCH}_3$
 (b) $\text{CH}_3(\text{CH}_2)_4\text{CHO}$
 (c) $\text{CH}_3(\text{CH}_2)_4\text{COOH}$
 (d) $\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{OH}$

NIOS Board-2018

Ans. (b)



In the above reaction sequence, Z is :

- (a) $\text{CH}_2 = \text{CH}_2$
- (b) $\begin{matrix} \text{CH}_2 - \text{OH} \\ | \\ \text{CH}_2 - \text{OH} \end{matrix}$
- (c) $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_3$
- (d) $\text{CH}_3 - \text{CH}_2 - \text{OH}$

NIOS Board-2021

Ans. (d)

11. Ethylene glycol forms terylene with:

- (a) Adipic acid
- (b) Phthalic anhydride
- (c) Terephthalic acid
- (d) Oxalic acid

Tamil Nadu Board-2016

Ans. (c)

12. Ethanol upon heating with conc. H_2SO_4 at 443 k gives:

- (a) Diethyl ether
- (b) Ethylene
- (c) Ethyl hydrogen sulphate
- (d) none of these

Punjab Board-2021

Ans. (a)

13. Which product is obtained when 2-methyl propane – 2 – ol is reacted with copper catalyst at 573K temperature followed by dehydration.

- (a) Acetone
- (b) Ethanal
- (c) Diethyl ether
- (d) 2-methyl propene

Gujarat Board-2019

Ans. (d)

14. Ethyl bromide + KOH(aq) $\xrightarrow{\text{Boil}}$ A 'A' is

- (a) Ethyl alcohol
- (b) Ethylene
- (c) Propyl alcohol
- (d) None of these

Jharkhand Board-2020

Ans. (a)



- (a) Acetone
- (b) Propene
- (c) Propionaldehyde
- (d) None of these

Jharkhand Board-2020

Ans. (a)

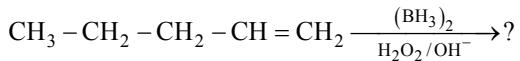
16. (xi) $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[413\text{ K}]{\text{conc. H}_2\text{SO}_4} \text{A}', \text{A}' \text{ will be :}$

- (a) $\text{CH}_2 = \text{CH}_2$
- (b) $\text{C}_2\text{H}_5\text{OCH}_3$
- (c) $(\text{C}_2\text{H}_5)_2\text{O}$
- (d) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

Haryana Board-2018

Ans. (c)

17. Name the product obtained in the following reaction?



Pent-1-ene

- | | |
|-----------------|-------------------------|
| (a) Pentan-3-ol | (b) Pentan-2-ol |
| (c) Pentan-1-ol | (d) 2-methyl butan-2-ol |

Gujarat Board-2018

Ans. (c) :

18. Give the IUPAC name of the product obtained when Phenol is oxidized by chromic acid.



- (a) Cyclohexa-2, 5-diene-1,4-dione
- (b) Cyclohexa-1,4-dione
- (c) Cyclohexanone
- (d) Cyclohexa-1, 4-diene-2,5-dione

Gujarat Board-2018

Ans. (c) :

19. What is obtained on oxidation of 2°-alcohol by chromic acid?

- (a) ester
- (b) aldehyde
- (c) carboxylic acid
- (d) ketone

Gujarat Board-2017

Ans.(d)

20. Substance A $\xrightarrow[573\text{K}]{\text{Cu}}$ Isobutylene which is the structural formula of substance A in this reaction?

- (a) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{OH}$
- (b) $\begin{matrix} \text{CH}_3 & - & \text{CH} & - & \text{CH}_2 & - & \text{CH}_3 \\ & | & & & & & \\ & \text{OH} & & & & & \end{matrix}$
- (c) $\begin{matrix} \text{CH}_3 & - & \text{CH} & - & \text{CH}_2 & - & \text{OH} \\ & | & & & & & \\ & \text{CH}_3 & & & & & \end{matrix}$
- (d) $\begin{matrix} \text{CH}_3 & - & \text{C} & - & \text{OH} \\ & | & & & \\ & \text{CH}_3 & & & \end{matrix}$

Gujarat Board-2019

Ans. (d)

21. On the basis of selectivity, which product is obtained by the reaction of $\text{CO}_{(g)}$ with $\text{H}_{2(g)}$ in presence of Ni catalyst?

- (a) CH_4
- (b) HCHO
- (c) CH_3OH
- (d) HCOOH

Gujarat Board-2020

Ans. (a)

22. Which one would be useful to distinguish between Phenol and Ethanol?

- (a) Sodium metal
- (b) Anhydronous $\text{ZnCl}_2 + \text{Conc. HCl}$
- (c) Neutral FeCl_3
- (d) All of them

Gujarat Board-2020

Ans. (a)

23. Phenols on reaction with conc. HNO_3 in the presence of conc. H_2SO_4 gives
 (a) o-nitrophenol
 (b) m-nitrophenol
 (c) p-nitrophenol
 (d) 2, 4, 6-trinitrophenol

Nagaland Board-2017

Ans. (d)

Section-B : Very Short Answer

1. Explain different Friedel-Crafts reaction of anisole.

Gujarat Board 2023 (March)

2. Explain dehydration reaction of alcohol to form alkene

Gujarat Board 2023 (March)

3. Explain the reaction Hydroboration oxidation to prepare propan-1-ol from propene.

Gujarat Board-2022 (July)

4. Give reason for the higher boiling point of ethanol in comparison to methoxymethane?

Haryana Board 2023

5. Phenol shows acidic character but ethanol remains approximately neutral. Why ?

UP Board 2023

6. Amines are less acidic than alcohols of comparable molecular masses.

Manipur Board 2020

7. A solution of bromine in methanol or ethanol cannot be used for the detection of unsaturation in organic compounds. Why?

Manipur Board 2020

8. Write the mechanism for the preparation of alcohols from alkenes (Acid Catalyzed Hydration).

CBSE-2020

9. Assertion (A): p-nitro phenol is a stronger acid than p-cresol.

Reason (R): NO_2 group is an electron releasing group while $-\text{CH}_3$ group is electron withdrawing in nature.

(a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is correct, but Reason (R) is incorrect statement.

(d) Assertion (A) is incorrect, but Reason (R) is correct statement.

CBSE-2020

10. Assertion (A) : Ortho and para-nitrophenols can be separated by steam distillation.

Reason (R) : Ortho isomer associates through intermolecular hydrogen bonding while Para isomer associates through intramolecular hydrogen bonding.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is wrong statement.
 (d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

11. Write the structures of the products when
 (i) Phenol is treated with bromine water, and
 (ii) Propanol is heated with Cu at 573 K.

CBSE-2021

12. Carry out the following conversions:

- (i) Ethanol to ethyl cyanide.
 (ii) Phenol to acetophenone.

CBSE-2021

13. Assertion : p-nitrophenol is more acidic than phenol.
 Reason: Nitro group is electron withdrawing group and stabilizes p-nitrophenoxide ion.

- (a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.
 (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.
 (c) Assertion is a correct statement, but Reason is a wrong statement.
 (d) Assertion is a wrong statement, but Reason is a correct statement.

CBSE-2021

14. (a) Write structures of the products formed when:

- (a) Propan-2-ol is heated with Cu at 573 K.
 (b) Salicylic acid is treated with $(\text{CH}_3\text{CO})_2\text{O}/\text{H}^+$.

CBSE-2021

15. (b) Carry out the following conversions:

- (d) Phenol to Anisole
 (d) Aniline to Phenol

CBSE-2021

16. Assertion: Ortho- nitrophenol is more acidic than phenol.

Reason: Nitro group is electron donating group and therefore stabilizes ortho-nitrophenoxide ion.

- (a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.

- (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.

- (c) Assertion is a correct statement, but Reason is a wrong statement.
 (d) Assertion is a wrong statement, but Reason is a correct statement.

CBSE-2021

17. Write the equations involved in the following reactions :

- (a) Kolbe's reaction
 (b) Friedel-Crafts alkylation of anisole

CBSE-2019

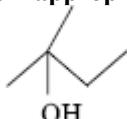
18. What happens when

- (a) Phenol reacts with Conc. HNO_3 ?
 (b) Ethyl chloride reacts with NaOC_2H_5 ?

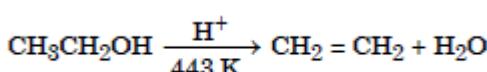
Write the chemical equations involved in the above reactions.

CBSE-2019

19. (a) How will you synthesise the following alcohol from appropriate alkene :



- (b) Write the mechanism of the following reaction:



CBSE-2019

20. Give balanced equation for the preparation of salicylaldehyde from phenol.

ISC Board-2013

21. Carry out the following conversion:

Ethanol to acetone

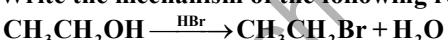
ISC Board-2011

22. How would you obtain

- (i) picric acid from phenol?
 (ii) 2-methyl propanol from 2-methyl propene?

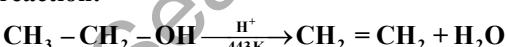
Delhi 2011

23. Write the mechanism of the following reaction:



Foreign 2014; Delhi 2014

24. Explain the mechanism of the following reaction:



All India 2013

25. How will you convert the following.

- (i) Propan-2-ol to propanone?
 (ii) Phenol to 2,4,6-tribromophenol?

Delhi 2013

26. Write the mechanism of acid dehydration of ethanol to yield ethene.

All India 2015C

27. Explain the mechanism of dehydration steps of ethanol:



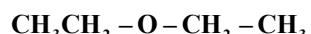
Delhi 2015C

28. (i) Arrange the following compounds in the increasing order of their acidic strength:
 p-cresol, p-nitrophenol, phenol
 (ii) Write the mechanism (Using curved arrow notation) of the following reactions.



All India 2017

29. Write the mechanism of the following reaction.



Delhi 2016

30. How is toluene obtained from phenol?

Delhi 2013C

31. Phenol on oxidation with air gives _____.

Odisha Board-2017

32. Write the method of preparation of phenol from chlorobenzene by Dow's process. What happens when phenol reacts with (i) conc. H_2SO_4 and (ii) acetyl chloride in presence of aqueous NaOH solution?

Odisha Board-2020

33. What happens when ethyl alcohol is heated with excess conc. H_2SO_4 at 160°C ?

Odisha Board-2020

34. Write mechanism of acid dehydration of ethanol to yield ethene.

Manipur Board-2017

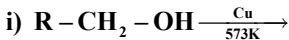
35. Give two reactions that show the acidic nature of phenol.

Manipur Board-2017

36. Name the product formed when phenol is treated with acidified solution of $\text{Na}_2\text{Cr}_2\text{O}_7$. Give equation.

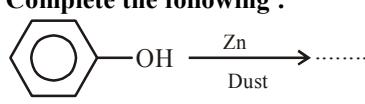
Karnataka Board-2015

37. Complete the following reaction:



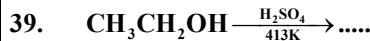
Karnataka Board-2014

38. Complete the following :



Phenol

Punjab Board-2019

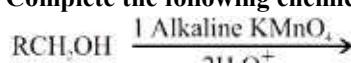


Haryana Board-2021

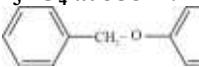
40. Explain Reimer-Tiemann reaction with an example.

Karnataka Board-2016

41. Complete the following chemical reaction

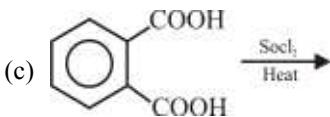


Karnataka Board-2016

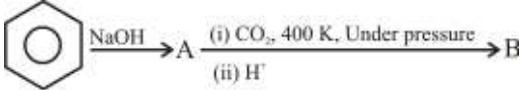
42. How does phenol react with conc. nitric acid? Give equation. Karnataka Board-2018
43. How does phenol react with conc. Nitric acid? Give equation. Karnataka Board-2019
44. Convert the following:
(iv) Ethanol to Ethene Haryana Board-2016
45. Convert the following:
(v) Ethanol to Propanenitrile Haryana Board-2016
46. Convert the following:
(i) Propene to Propan-1-ol Haryana Board-2016
47. How will you convert phenol to benzene? Rajasthan Board-2014
48. Write the main product(s) in each of the following reactions:
- (i) $\text{CH}_3 - \underset{\text{CH}_3}{\underset{|}{\text{C}}} - \text{O} - \text{CH}_3 + \text{HI} \rightarrow$
- (ii) $\text{CH}_3 - \text{CH} = \text{CH}_2 \xrightarrow[\text{[ii] } 3\text{H}_2\text{O}_2/\text{OH}^-]{\text{[i] B}_2\text{H}_6} \cdots$
- (iii) $\text{C}_6\text{H}_5 - \text{OH} \xrightarrow[\text{[ii] CO}_2, \text{H}^+]{\text{[i] aq. NaOH}} \cdots$
- Assam Board-2020
49. Write the Reimer-Tiemann reaction. Assam Board-2020
50. Complete the following equations:
(a) $\text{C}_2\text{H}_5\text{OH} + \text{SOCl}_2 \rightarrow ?$
(b) $\text{CH}_2 = \text{CH}_2 + \text{Br}_2 \xrightarrow{\text{CCl}_4} ?$
(c) $2 \text{C}_6\text{H}_5\text{Cl} + 2\text{Na} \xrightarrow{\text{dry ether}} ?$
- Assam Board-2015
51. (a) Complete the following reaction:
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{SOCl}_2 \rightarrow ?$
(b) An alkylchloride (X) reacts with magnesium metal in presence of dry ether followed by treatment of ethanol gives propane. Write the structure of the alkylchloride (X). Assam Board-2013
- Section-C : Short Answer**
- Why is p-nitrophenol more acidic than phenol? Gujarat Board 2023 (July)
 - Write four differences between alcohol and phenol. MP Board 2020
 - Name the products formed when phenol is treated with the following reagents.
(i) Bromine water
(ii) Zinc dust
(iii) Conc HNO_3 Kerala Board 2023
4. Illustrate Hell-Volhard-Zelinsky reaction of 2-methylpropanoic acid. Manipur Board 2023
5. Why is o-chlorophenol more acidic than phenol? Manipur Board 2023
6. Give the structures of final products expected from the following reactions:
(i) Hydroboration of propene followed by oxidation with H_2O_2 in alkaline medium.
(ii) Dehydration of $(\text{CH}_3)_3\text{C}-\text{OH}$ by heating it with 20% H_3PO_4 at 358 K.
(iii) Heating of  With HI. CBSE-2020
7. Write equations of the following reactions:
(a) Friedel-Crafts reaction – alkylation of anisole
(b) Nitration of Phenol with concentrated nitric acid CBSE-2021
8. An organic compound 'X' with the molecular formula $\text{C}_5\text{H}_{10}\text{O}$ forms 2,4-DNP derivative, does not reduce Tollens' reagent but gives positive iodoform test on heating with I_2 in the presence of NaOH . Compound 'X' gives ethanoic acid and propanoic acid on vigorous oxidation. Write the
(i) Structure of the compound 'X'.
(ii) Structure of the product obtained when compound 'X' reacts with 2,4-DNP reagent.
(iii) Structure of the product obtained when compound 'X' is heated with I_2 in the presence of NaOH . CBSE-2022
9. An aromatic compound 'A' ($\text{C}_7\text{H}_6\text{O}_2$) on reaction with aqueous ammonia and heating forms compound 'B'. 'B' on heating with Br_2 and alcoholic potash forms a compound 'C' of molecular formula $\text{C}_6\text{H}_7\text{N}$. Write the reactions involved and identify 'A', 'B', 'C'. CBSE-2022
10. Give one chemical test to distinguish between the following:
(a) Phenol and 1-propanol
(b) Ethanol and dimethyl ether
(c) 1-propanol and 2-Methyl-2-propanol CBSE-2019
11. (a) Give equations of the following reactions:
(i) Phenol is treated with conc. HNO_3 .
(ii) Propene is treated with B_2H_6 followed by $\text{H}_2\text{O}_2/\text{OH}^-$.
(iii) Sodium t-butoxide is treated with CH_3Cl .
(b) How will you distinguish between butan-1-ol and butan-2-ol?
(c) Arrange the following in increasing order of acidity:
Phenol, ethanol, water CBSE-2019

14. (a) How can you obtain Phenol from (i) Cumene, (ii) Benzene sulphonic acid, (iii) Benzene diazonium chloride?
 (b) Write the structure of the major product obtained from dinitration of 3-methylphenol.
 (c) Write the reaction involved in Kolbe's reaction.
- CBSE-2019
13. (a) Account for the following :
 (i) o-nitrophenol is more steam volatile than p-nitrophenol.
 (ii) t-butyl chloride on heating with sodium methoxide gives 2-methylpropene instead of t-butylmethylether.
 (b) Write the reaction involved in the following :
 (i) Reimer-Tiemann reaction
 (ii) Friedal-Crafts Alkylation of Phenol
 (c) Give simple chemical test to distinguish between Ethanol and Phenol.
- CBSE-2019
14. (a) Predict the products of the following:
- $$\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[\text{H}_2\text{SO}_4]{\text{K}_2\text{Cr}_2\text{O}_7} \text{A} \xrightarrow{\text{SOCl}_2} \text{B} \xrightarrow{\text{NH}_3} \text{C}$$
- ↓
NaOB_r
D
- (b) Arrange the following in increasing order of acidic character:
 HCOOH, CF₃COOH, ClCH₂COOH, CCl₃COOH
- CBSE-2019
15. (a) How will you convert the following :
 (i) Phenol to benzoquinone
 (ii) Propanone to 2-methyl propan-2-ol
 (b) Why does propanol have higher boiling point than that of butane ?
- CBSE-2019
16. What happens when
 (a) Sodium phenoxide is treated with CH₃Cl ?
 (b) CH₂ = CH - CH₂ - OH is oxidised by PCC ?
 (c) Phenol is treated with CH₃COCl/anhydrous AlCl₃?
 Write chemical equations in support of your answer.
- CBSE-2019
17. What happens when
 (a) Salicylic acid is treated with (CH₃CO)₂O/H⁺ ?
 (b) Phenol is oxidised with Na₂Cr₂O₇/H⁺ ?
 (c) Anisole is treated with CH₃Cl/anhydrous AlCl₃ ?
 Write chemical equation in support of your answer.
- CBSE-2019
18. How would you obtain the following.
 (i) Benzoquinone from phenol?
 (ii) 2-methyl propan-2-ol from methyl magnesium bromide?
- (iii) Propan-2-ol from propene?
 All India 2011; Foreign 2011
19. (i) Write the mechanism of the following reaction.
 $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{HBr}} \text{CH}_3\text{CH}_2\text{Br} + \text{H}_2\text{O}$
 (ii) Write the equations involved in Reimer-Tiemann reaction.
- All India 2014
20. Write the main product(s) in each of the following reactions:
- (i) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{O}-\text{CH}_3 + \text{HI} \\ | \\ \text{CH}_3 \end{array}$
- (ii) $\text{CH}_3-\text{CH}=\text{CH}_2 \xrightarrow[\text{(ii)}{3\text{H}_2\text{O}_2/\text{OH}^-}]{} \text{CH}_3-\text{CH}_2-\text{CH}_2\text{OH}$
- (iii) $\text{C}_6\text{H}_5-\text{OH} \xrightarrow[\text{(ii)}{\text{CO}_2,\text{H}^+}]{} \text{C}_6\text{H}_5-\text{O}-\text{CH}_3$
- All India 2016
21. Write the final product(s) in each of the following reactions:
- (i) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{O}-\text{CH}_3 + \text{HI} \longrightarrow \\ | \\ \text{CH}_3 \end{array}$
- (ii) $\text{CH}_3-\text{CH}_2-\text{CH}(\text{OH})-\text{CH}_3 \xrightarrow{\text{Cu}/573\text{K}} \text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_3$
- (iii) $\text{C}_6\text{H}_5-\text{OH} \xrightarrow[\text{(ii)}{\text{H}^+}]{} \text{C}_6\text{H}_5-\text{O}-\text{CH}_3$
- Delhi 2015
22. Write the following reactions of Phenol–
 (a) Reaction of Phenol with con. HNO₃
 (b) Kolbe's reaction
 (c) Reimer – Tiemann reaction
- Uttarakhand Board-2020
23. Write following conversion in two steps :
 Phenol to salicylic acid
- Gujarat Board-2021
24. Write only the structure of the major product formed when ethanal reacts with each of the following reagents:
 (a) HCN
 (b) Zn-Hg/conc. HCl
- Goa Board-2023
25. Explain the following reactions with equations.
 (a) Kolbe's reaction
 (b) Riemer – Tiemann reaction
 (c) Williamson's ether synthesis
 (d) HVZ reaction
- Telangana Board-2023
26. Explain Nitration and Bromination reaction of phenol.
- Gujarat Board-2016
27. Give the mechanism involved in esterification reaction.
- Tamil Nadu Board-2015
28. Give short notes on Riemer- Tiemann reaction.
- Tamil Nadu Board-2015
29. how is tertiary butyl alcohol converted to isobutylene?
- Tamil Nadu Board-2011

30. When phenol is distilled with zinc dust, it gives
 (a) benzaldehyde
 (b) benzoic acid
 (c) toluene
 (d) benzene
- Tamil Nadu Board-2011
31. (a) How can you prepare phenol from benzenediazonium chloride? Give its reaction with (i) Excess of Aqueous bromine solution and (ii) Zinc dust
 (b) Write two uses of phenol
- Odisha Board-2023
32. Write reactions of phenol with bromine
 a) in aqueous solution and
 b) in less polar solvent such as carbon disulphide
- NIOS Board-2021
33. What is the action of oxalic acid on glycerol at 533 K?
- Tamil Nadu Board-2016
34. Write the equation for action of heat on ethylene glycol with conc. Phosphoric acid.
- Tamil Nadu Board-2016
35. Complete the reaction and write the name of the product.
 $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[620\text{k}]{\text{Al}_2\text{O}_3}$
- Tamil Nadu Board-2018
36. (a) Describe iodoform test. What type of compounds will give a positive iodoform test?
 (b) Give reason for each of the following :
 (i) Phenols are more acidic than alcohols.
 (ii) Ethers are polar in nature.
- NIOS Board-2012
37. (a) Write the IUPAC name of the following compound :
 $\text{CH}_3 = \text{CH} - \underset{\text{C}_2\text{H}_5}{\overset{|}{\text{C}}} \text{H} - \underset{\text{CH}_3}{\overset{|}{\text{C}}} \text{H} - \text{CH}_3$
 (b) Name the product formed when phenol reacts with chlorine in the presence of FeCl_3 .
- NIOS Board-2012
38. (i) Write the structural formulae of A, B, C, D in the following reaction :
-
- (ii) Write equation of the following conversion : Salicylic acid to aspirin.
- West Bengal Board-2019
39. How does PCl_5 react with the following?
 (a) Water
 (b) $\text{C}_2\text{H}_5\text{OH}$
 (c) CH_3COOH
 (d) Ag
- Andhra Pradesh Board-2020
40. Write equation of chemical conversions for following organic compounds
 (a) Acetaldehyde to butan-2-ol
 (b) Aniline to phenol
- Gujarat Board-2019
41. $\text{CH}_3 > \text{CH} - \text{OH} \xrightarrow[300^\circ\text{C}]{\text{Cu powder}} \dots$
- Haryana Board-2022
42. (a) What is meant by Hydroboration-oxidation reaction ? Illustrate it with an example
 (b) Predict the major product of acid catalysed dehydration of 1-methylcyclohexanol.
- Haryana Board-2019
43. What is the action of the following on ethyl bromide
 (a) alcoholic solution of potassium hydroxide
 (b) moist silver oxide
 (c) silver acetate?
- Maharashtra board-2019
44. Identify A, B and C in the following reactions :
 $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{[o]} \text{A} \xrightarrow{[o]} \text{B} \xrightarrow[\text{[H]}]{\text{LiAlH}_4} \text{C}$
- Chhattisgarh Board-2022
45. Identify A and B in the following reactions :
 (i) $\text{C}_6\text{H}_5\text{CH}_2\text{Br} \xrightarrow{\text{KCN}} \text{A} \xrightarrow[\text{H}_3\text{O}^+]{\text{A}} \text{B}$
 (ii) $\text{CH}_3\text{CHO} \xrightarrow{\text{CH}_3\text{Mg Br}} \text{A} \xrightarrow{+\text{H}_2\text{O}} \text{B}$
- Chhattisgarh Board-2021
46. Give balanced equations for the following reactions:
 (i) Methyl magnesium bromide with ethyl alcohol.
- ISC Board-2017
47. What are the products formed when phenol and nitrobenzene are treated separately with a mixture of concentrated sulphuric acid and concentrated nitric acid?
- ISC Board-2017
48. Complete the following reactions:
- (a) $\text{H}_3\text{C} \begin{array}{c} \text{O} \\ || \\ \text{C} - \text{CH}_2\text{CH}_2 - \text{C} - \text{OCH}_3 \end{array} \xrightarrow{\text{NaBH}_4} ?$
- (b) $\text{C}_6\text{H}_5\text{OH} \xrightarrow{\text{Br}_2 - \text{H}_2\text{O}} ?$
- (c) $\text{C}_6\text{H}_5\text{OH} + \text{CHCl}_2 + \text{NaOH(aq)} \rightarrow ?$
- Assam Board-2014
49. Predict the product in the following :
 (a) $\text{CH}_3\text{OH} + \text{PCl}_5 \rightarrow$
 (b) $\text{CH}_3 - \text{CH} = \text{CH}_2 \xrightarrow{\text{H}_2\text{O}/\text{H}^+} ?$

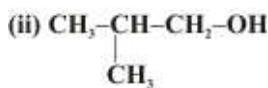
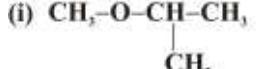


Jharkhand Board-2020

50. What is Reimer-Tiemann reaction?
Haryana Board-2017
51. What is Fermentation? How is Ethyl alcohol obtained from molasses? [3]
Uttarakhand Board-2019
52. How will you synthesize the isomeric ether of benzyl alcohol by Williamson synthesis?
Manipur Board-2019
53. Starting from phenol how can you prepare methoxy benzene ? Give the name of the method.
Manipur Board-2022
54. Write chemical equation to show what happens when:
 (a) Phenol reacts with Bromine water.
 (b) Ethanol reacts with conc. sulphuric acid at 413 K
 (c) Methanal is treated with ethyl magnesium bromide followed by hydrolysis.
Goa Board-2019
55. Complete the following:

Haryana Board-2016
56. Write the Equations for the reaction of phenol with the following:
 (i) Br₂ Water
 (ii) CHCl₃ + NaOH
 (iii) Na₂Cr₂O₇ + Conc. H₂SO₄
Haryana Board-2018
57. Complete the following reaction sequence and write the names of products [A] and [B].

Rajasthan Board-2020
58. Write chemical equation of phenol with chloroform and KOH.
Rajasthan Board-2018
59. How to convert methanol into ethanol? Write chemical equations only.
Rajasthan Board-2018
60. Write the mechanism of dehydration of ethanol to form ethene.
Rajasthan Board-2018
61. Complete the following reaction.
 $\text{C}_2\text{H}_5\text{OH} + \text{PCl}_5 \rightarrow$
Rajasthan Board-2018
62. Give resonating structures of anisole.
Rajasthan Board-2017

63. Write IUPAC names of the following compounds :



Rajasthan Board-2015

64. Write equations of the following chemical reactions :

- (i) Phenol reacts with conc. HNO₃
 (ii) Phenol reacts with zinc dust.

Rajasthan Board-2015

65. Write equations of the following chemical reactions :

- (i) Phenol reacts with Br₂ in presence of CS₂
 (ii) Ethanol is heated at 573 K in presence of Cu.

Rajasthan Board-2015

66. Give equations for preparation of phenol from the following compounds:

- (i) Benzene (ii) Aniline

Rajasthan Board-2013

67. Write the equations for dehydrogenation reactions of primary and secondary alcohol.
Rajasthan Board-2010

46. Give the oxidation reaction of phenol.
Tamilnadu Board, Sep.-2016

68. Convert Glycerol into Acrolein.
Tamilnadu Board, March-2016

69. How do you convert the following?

- (i) Phenol to anisole
 (ii) Propan-2-ol to 2-methylpropan-2-ol
 (iii) Aniline to phenol

Assam Board-2020

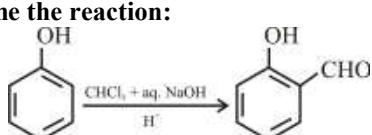
70. Give equation for chemical reactions to carry out following conversions.

- (a) Cumene from phenol
 (b) Phenol from aniline

Gujarat Board-2017

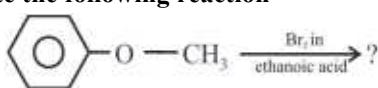
71. Explain Kolbe-Schmitt reaction and Fries rearrangement reaction.
Gujarat Board-2017

72. Name the reaction:



Assam Board-2019

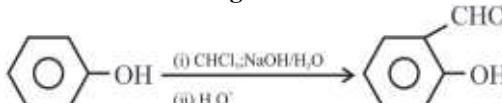
73. Complete the following reaction-



Assam Board-2018

74. What happens when phenol is heated with Zn dust? Given chemical equation.
Assam Board-2016

75. Name the following chemical reaction:



Assam Board-2016

76. How will you convert the following? Give chemical equations only.

- (a) Benzene to phenol
- (b) Aniline to phenylisocyanide

Assam Board-2013

77. (i) How will you obtain from phenol:

- (a) 2, 4, 6 Tribromo Phenol
- (b) Picric -Acid

- (ii) What is the reaction of Diethyl ether with HI-Acid.

MP Board-2016

78. How can the following compounds be obtained from phenol? Give equation:

- (i) 2, 4, 6-Tribromophenol
- (ii) 2, 4 6-Trinitrophenol
- (iii) Benzene
- (iv) Ortho-and para-cresol.

MP Board-2014

79. Give chemical equations of the following conversions:

- (a) Ethyl acetate from Ethanol
- (b) Ethanol from Glucose

MP Board-2012

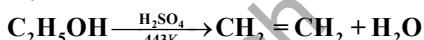
80. Why are phenols more acidic than alcohols? What happen when phenol is treated with excess of aqueous bromine solution?

Nagaland Board-2018

Section-D : Case Based Study

1. (a) How do you convert the following :

- (i) Phenol to Anisole
- (ii) Ethanol to Propan-2-ol
- (b) Write mechanism of the following reaction :



- (c) Why phenol undergoes electrophilic substitution more easily than benzene ?

CBSE-2019

2. An organic compound A ($\text{C}_6\text{H}_6\text{O}$) gives violet colour with neutral FeCl_3 . A gives two isomers B and C, when an alkaline solution of A is refluxed with CCl_4 . A also reacts with formaldehyde and sodium hydroxide to give compound D. Identify A, B, C and D. Explain with suitable chemical reactions.

Tamil Nadu Board-2011

3. An organic compound 'A' is a sodium salt of phenolic acid with molecular formula $\text{C}_7\text{H}_5\text{O}_3\text{Na}$, 'A' on heating with soda lime gives compound 'B' of molecular formula $\text{C}_6\text{H}_6\text{O}$. 'B' gives violet colour with neutral ferric chloride. 'B' on treatment with $\text{C}_6\text{H}_5\text{COCl}$ in the presence of NaOH gives an ester 'C' identify 'A', 'B' and 'C'. Explain the reactions.

Tamil Nadu Board-2016

4. 'A' is a yellow coloured metal soluble in aqua regia. The roasted ore of this metal reacts with dil. KCN to form a soluble complex 'B'. This complex 'B' reacts with Zinc dust to form another complex 'C' along with the metal 'A'. Identify 'A', 'B' and 'C'. Explain the reactions.

Tamil Nadu Board-2016

Section-E : Long Answer

5. (a) Out of t-butyl alcohol and n-butanol, which one will undergo acid catalyzed dehydration faster and why?

- (b) Carry out the following conversions:

- (i) Phenol to Salicylaldehyde
- (ii) t-butylchloride to t-butyl ethylether
- (iii) Propene to Propanol

CBSE-2020

6. (a) How are the following conversions carried out:

- (i) Phenol to Toluence

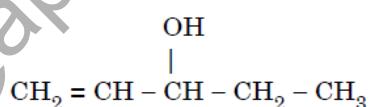
- (ii) Ethanol to Methane

- (b) Give chemical tests to distinguish between the following pairs of compounds:

- (i) Methanol and Ethanol

- (ii) p-Methyl phenol and Methoxy benzene

- (c) Write IUPAC name of



CBSE-2019

- (a) Write mechanism for the dehydration of alcohols in the presence of concentrated sulphuric acid.

- (b) Give reasons:

- (i) C – O bond is much shorter in phenol than in ethanol

- (ii) Boiling point of ethanol is higher in comparison to

CBSE-2019

7. Write chemical equation to show what happens when:

- (a) Phenol reacts with Bromine water.

- (b) Ethanol reacts with conc. sulphuric acid at 413 K

- (c) Methanal is treated with ethyl magnesium bromide followed by hydrolysis.

Goa Board-2023

8. An organic compound A ($\text{C}_2\text{H}_6\text{O}$) liberates hydrogen with sodium metal.

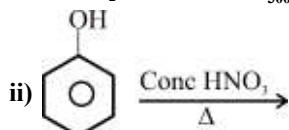
- A when heated with alumina at 620 K gives an alkene B which when passed through Bayer's reagent gives $\text{C}(\text{C}_2\text{H}_6\text{O}_2)$. C reacts with PI_3 and gives back B. Identify A, B and C. Write the reactions.

Tamil Nadu Board-2011

10. The chief ore of chromium A on roasting with molten sodium carbonate gives compound B. Compound B on acidification with conc. H_2SO_4 gives compound C. Compound C on treatment with KCl gives compound D. identify A, B, C and D. Explain the reactions.
Tamil Nadu Board-2011
11. Write the mechanism of esterification reaction.
Tamil Nadu Board-2011
12. How is acrolein formed?
Tamil Nadu Board-2011
13. (a) Explain the following :
 (i) Phenol gives 2, 4, 6 tribromophenol on bromination with bromine water.
 (ii) Ethers are polar in nature.
 (iii) Methanal does not undergo aldol condensation.
 (iv) Chloroethanoic acid is stronger acid than ethanoic acid.
 (b) With the help of suitable example explain Hell – Volhard Zelinsky reaction.
NIOS Board-2019
14. Write the name and structures of A, B, C and D in the following sequence of reactions :
- $$\begin{array}{c} \text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{PCC}} \text{A} \xrightarrow{\text{dil NaOH}} \text{B} \xrightarrow{\Delta} \text{C} \\ \downarrow \text{NH}_2\text{OH} \\ \text{D} \end{array}$$
- NIOS Board-2019
15. (a) What happens when HCl reacts with propanol ? Write the reaction involved and write IUPAC name of the main product. This reaction occurs in presence of a substance. Name the substance and give its role.
 (b) Why do haloalkanes undergo nucleophilic substitution reactions ? What is a nucleophilic characteristics.
NIOS Board-2022
16. Write the names and formulas of A, B, C and D in the following sequential reactions:
- $$\begin{array}{c} \text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{PCC}} \text{A} \xrightarrow[\text{OH}^-]{\text{NaCl}_2} \text{B} \\ \downarrow \text{Ca(OH)}_2 \\ \text{D} \leftarrow \text{Light} \xrightarrow{\text{O}_2} \text{C} \end{array}$$
- NIOS Board-2019
17. The heat of combustion of ethyl alcohol is -330 kcal. If the heat of formation of $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ be -94.3 kcal and -68.5 kcal respectively, then calculate the heat of formation of ethyl alcohol.
NIOS Board-2018
18. a) Explain the mechanism for acid catalysed dehydration of ethanol to ethane.
 b) How does anisole react with methyl chloride?
Karnataka Board-2020
19. a) Write the mechanism of acid catalyzed dehydration of ethanol to ethene.
 b) Between phenol and alcohol which is more acidic? Why?
Karnataka Board-2018
20. a) Explain Kolbe reaction with equation.
 b) Write the three steps involve in the mechanism of acid catalysed dehydration of ethanol to ethene.
Karnataka Board-2017
21. a) Write equations for the steps in S_N^1 mechanism of the conversion of tertiary butyl bromide in to tertiary butyl alcohol
 b) Identified the products A, B and C in the following equation.

$$\text{CH}_3\text{OH} \xrightarrow[\text{Cl}_2]{\text{Red}} \text{A} \xrightarrow[\text{dry acetone}]{\text{NaI}} \text{B} \xrightarrow[\text{Na and dry ether}]{\text{C}_6\text{H}_5\text{I}} \text{C}$$

Karnataka Board-2015
22. a) Write the mechanism of acid catalysed dehydration of ethanol to ethene.
 b) Explain Williamson's reaction. Write the general equation.
Karnataka Board-2015
23. Give three methods of preparation of anisole.
Tamil Nadu Board-2018
24. (a) Write the structures of A, B, C and D in the following reactions:
 (i)  $\xrightarrow[\text{conc. H}_2\text{SO}_4]{\text{conc. HNO}_3} \text{A} \xrightarrow{\text{Sn/HCl}} \text{B}$
 (ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CONH}_2 \xrightarrow{\text{Br}_2/\text{KOH}} \text{C} \xrightarrow[273\text{K}-278\text{K}]{\text{NaNO}_2/\text{HCl}} \text{D}$
 (b) Exemplify the following reactions:
 (i) Aldol condensation
 (ii) Hell-Volhard-Zelinsky reaction
NIOS Board-2016
25. Identify the main product formed when propan-I-ol is reacted with SOCl_2 . Write the chemical equation involved. Identify the products formed when the main product formed in the above reaction is reacted with each of the following reactants and write the chemical equations involved:
 (a) Alcoholic solution of KOH
 (b) Mg in the presence of dry ether
 (c) H_2 in the presence of Ni or P
NIOS Board-2014
26. Describe the following :
 (a) Aldl condensation
 (b) Decarboxylation
Haryana Board-2019
27. (a) Write the three steps involved in the mechanism of acid catalysed dehydration of ethanol to ethene.
 (b) Identify the products A and B in the following equation:
Karnataka Board-2020
28. a) Explain the Kolbe's reaction.
 b) Complete the reactions:



c) Write the general equation of Williamson's ether synthesis. (2+2+1)

Karnataka Board-2015

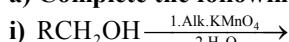
29. (a) Write the mechanism of acid catalysed dehydration of ethanol to ethene.
 (b) Explain Reimer-Tiemann reaction with an example.

Karnataka Board-2017

30. a) Write the mechanism of acid catalysed dehydration of ethanol to ethene.
 b) How does anisole react with bromine in Ethanoic acid? Give equation.

Karnataka Board-2018

31. a) Complete the following equations:



- b) Explain Aldol condensation reaction for acetaldehyde. Write equation.
 c) What is Formalin solution?

Karnataka Board-2019

32. Write Down process for preparation of Phenol. What is the action of bromine water on phenol ?

Give reason : Group 16th elements have lower ionisation enthalpy compared to group 15th elements.

Write two uses of dioxygen.

Maharashtra board-2023

- 33.(a) Phenol when treated with conc. HNO_3 gives
 (a) o-Nitrophenol
 (b) p-Nitrophenol
 (c) 2,4,6-Trinitro phenol
 (d) A mixture of o-nitrophenol and p-nitrophenol
 (b) Methanol and ethanol are two commercially important alcohols. Write one method each for the preparation of methanol and ethanol.

Kerala Board-2016

34. A compound X having the molecular formula $\text{C}_3\text{H}_7\text{NO}$ reacts with bromine in presence of NaOH to give a compound Y. The compound Y reacts with $\text{NaNO}_2 + \text{HCl}$ to form ethanol and nitrogen gas. Identify the compounds X and Y and write the chemical equations involved.

Goa Board-2019

35. Name the two organic compounds which have the same molecular formula $\text{C}_2\text{H}_6\text{O}$. Will they react with PCl_5 ? If they react, what are the products formed?

ISC Board-2017

36. Explain the mechanism of dehydration of ethanol.

Haryana Board-2016

37.

Ether

(a) A sample of rubbing alcohol contains 122 g of isopropyl alcohol ($\text{C}_3\text{H}_7\text{OH}$) and 55 g of water. What are the mole fractions of alcohol and water ?

(b) The freezing point depression constant (K_f) values of water and cyclohexane are $1.86 \text{ K kg mol}^{-1}$ and $20.1 \text{ K kg mol}^{-1}$ respectively. Which one of the two solvents will be used in measuring freezing point depression for determining the molar mass of an unknown soluble solute ? Give reason.

(c) How does common salt added on meat as preservative prevent growth of bacteria ?

Manipur Board-2022

38.

Write the equations for the reaction of Phenol with the following:

- (i) Bromine (Br_2) water
 (ii) Zinc

Haryana Board-2018

39.

How will you obtain p-hydroxybenzaldehyde from phenol? Give chemical equation.

Rajasthan Board-2018

40.

(a). An organic compound (A) molecular formula CH_2O reacts with CH_3MgI to give compound (b). Compound (B) liberates Hydrogen with metallic sodium. Compound (B) in the presence of Con. H_2SO_4 at 410 k on dehydration to give compound (C) molecular formula $\text{C}_4\text{H}_{10}\text{O}$. Identify (A),(B) and (C). Explain the above reactions.

Tamilnadu Board, Sep.-2016

41.(a)

An organic compound (A) molecular formula $\text{C}_6\text{H}_6\text{O}$ gives violet colour with neutral ferric chloride. Compound (A) reacts with metallic sodium and gives compound (B). When compound (B) is heated with CO_2 at 400 K under pressure gives compound (C). With dilute HCl compound (C) reacts and gives compound (D). Identify (A),(B),(C) and (D) and explain the reactions.

Tamilnadu Board, March-2016

42.

Explain the industrial production of phenol of high purity and less production cost and also explain the bromination of phenol.

Gujarat Board-2018

43.

Write the reaction to prepared salicylic acid from phenol and state the structural formula and use of methyl salicylate and Aspirin.

Gujarat Board-2018

44.

Explain the following with an example:

- (i) Kolbe's reaction

Assam Board-2019

45.

Reimer-Tiemann reaction.

Assam Board-2019

46.

(a) How will you convert the following? Give equations only

- (i) Benzene to acetophenone

- (ii) Propene to acetone

(b) An organic compound (A) (molecular Formula, $\text{C}_4\text{H}_8\text{ O}_2$) was hydrolysed with dilute H_2SO_4 to give a carboxylic acid (B) and alcohol

(C). Oxidation of (C) with chromic acid produced (B). Write possible structures of (A), (B) and (C) and give their IUPAC name. Write the chemical equations involved in the process.

Assam Board-2012

47. What do you understand by dehydration of alcohol? Explain its mechanism. MP Board-2018
48. How will you obtain the following from Phenol (give equation):
 (a) 2, 4, 6 Trinitrophenol
 (b) 2, 4, 6 Tribromophenol
 (c) Benzene
 (d) Ortho and Para-Cresol. MP Board-2012

D. Properties of Alcohol

Section-A : Multiple Choice Questions

1. Which compound highest value of pKa?
 (a) m-nitrophenol (b) phenol
 (c) p-cresol (d) o-nitrophenol

Gujarat Board 2023 (March)

Ans. (a)

2. Which compound will give yellow precipitate on reaction with sodium hypoiodite?
 (a) sec-Butyl alcohol (b) tert-Butyl alcohol
 (c) isobutyl alcohol (d) n-Butyl alcohol

Gujarat Board 2023 (March)

Ans. (a)

3. The correct ascending order of boiling points of CH_3OCH_3 , $\text{CH}_3\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{CH}_3$ is –
 (a) $\text{CH}_3\text{CH}_2\text{OH} < \text{CH}_3\text{OCH}_3 < \text{CH}_3\text{CH}_2\text{CH}_3$
 (b) $\text{CH}_3\text{CH}_2\text{OH} < \text{CH}_3\text{CH}_2\text{CH}_3 < \text{CH}_3\text{OCH}_3$
 (c) $\text{CH}_3\text{CH}_2\text{CH}_3 < \text{CH}_3\text{OCH}_3 < \text{CH}_3\text{CH}_2\text{OH}$
 (d) $\text{CH}_3\text{CH}_2\text{CH}_3 < \text{CH}_3\text{CH}_2\text{OH} < \text{CH}_3\text{OCH}_3$

Rajasthan Board 2022

Ans. (c)

4. Alcohol are soluble in water because–
 (a) they have higher molecular weight than water
 (b) they form Hydrogen Bond with water
 (c) they displace water
 (d) None of these

Uttarakhand Board 2022

Ans. (b)

5. Assertion (A) : The C – O – H bond angle in alcohols is slightly less than the tetrahedral angle.

Reason (R) : This is due to the repulsive interaction between the two lone electron pairs on oxygen.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the

correct explanation of the Assertion (A).

- (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
 (d) Assertion (A) is incorrect, but Reason (R) is correct statement.

CBSE-2020

6. Which is the best reagent for gaining good product of aldehyde from primary alcohol?
 (a) KMnO_4 (b) PCC
 (c) CrO_3
 (d) Heating with Cu at 573 k

Gujarat Board-2021

Ans. (b)

7. Which of the following has highest value of pKa?
 (a) phenol (b) m-nitro phenol
 (c) p-nitrophenol (d) p-cresol

Gujarat Board-2021

Ans. (b)

8. Ethanoyl chloride + Ethanol \rightarrow A ‘A’ is
 (a) Methyl ethanoate (b) Ethyl ethanoate
 (c) Ethyl methanoate (d) None of these

Jharkhand Board-2018

Ans. (b)

9. Ethanol can be distinguished from methanol by the use of :
 (a) Tollen's reagent (b) Fehling's solution
 (c) $\text{I}_2 + \text{NaOH}$ (d) $\text{AgNO}_3(\text{aq})$

NIOS Board-2022

Ans. (c)

10. Which is Least Acidic?
 (a) $\text{C}_2\text{H}_5\text{OH}$ (b) CH_3COOH
 (c) $\text{C}_6\text{H}_5\text{OH}$ (d) ClCH_2COOH

Haryana Board-2022

Ans. (a)

11. Which of the following is most acidic ?
 (a) Benzylalcohol (b) Cyclohexanol
 (c) Phenol (d) M-Chlorophenol

Haryana Board-2021

Ans. (d)

12. Baeyer's reagent is –
 (a) acidified potassium dichromate
 (b) alkaline potassium dichromate
 (c) alkaline potassium permanganate
 (d) acidified potassium permanganate

Maharashtra board-2018

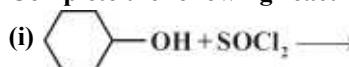
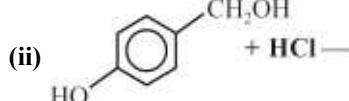
Ans. (c)

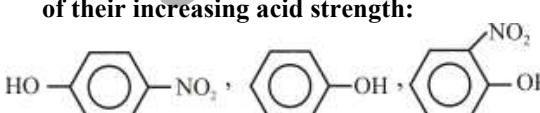
13. Which metal carbonyl has the strongest C–O bond?
 (a) $\text{Mn}(\text{CO})_6^+$ (b) $\text{Cr}(\text{CO})_6$
 (c) $\text{V}(\text{CO})_6$ (d) $\text{Fe}(\text{CO})_5$

Haryana Board-2017

Ans. (b)

14. The ease of dehydrohalogenation of alkyl halides with alcoholic KOH is:

12. (a) Butan-1-ol has a higher boiling point than diethyl ether. Why ?
 (b) Write the mechanism of the following reaction :
- $$2\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[413\text{K}]{\text{H}^+} \text{CH}_3\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_3$$
- CBSE-2019
13. Arrange the following in increasing order of their acidic character :
 Ethanol, Phenol, Water
 CBSE-2019
14. Arrange the following in increasing order of their boiling point :
 $\text{CH}_3\text{CH}_2\text{OH}, \text{CH}_3\text{CHO}, \text{CH}_3-\text{O}-\text{CH}_3$
 CBSE-2019
15. Give balanced chemical equation when phenol is heated with chloroform and sodium hydroxide.
 ISC Board-2009
16. Write the equation and name the following reaction: Phenol with acetyl chloride in the presence of AlCl_3 .
 ISC Board-2004
17. Give an example (equation) for the following name reaction:
 Reimer-Tiemann reaction
 ISC Board-2011
18. Outline the manufacture of methanol from water gas. Give equations and conditions only.
 ISC Board-2000
19. Explain what happens when ethanol is heated with acetic acid in presence of Conc. H_2SO_4 ?
 ISC Board-2000
20. Give balanced equations and explain what happen when glycerol reacts with conc. H_2SO_4 ?
 ISC Board-2000
21. Give one good chemical test to distinguish between the following pair of compounds:
 1-propanol and 2-propanol
 ISC Board-2010
22. How can the following conversion be brought about? 2-propanol to acetoxime
 ISC Board-2010
23. How is iodoform prepared from ethanol?
 Give the balanced equation.
 ISC Board-2015
24. Give one chemical test to distinguish between the following pairs of compounds: Ethanol and 2-propanol
 ISC Board-2014
25. Write chemical equations for the given reaction and name the main product.
 Oxalic acid with glycerol at 260°C .
 ISC Board-2005
26. Give chemical test to distinguish:
 Ethyl alcohol and sec-propyl alcohol.
 ISC Board-2017
27. Give balanced equation for the following:
 Glycerol is heated with oxalic acid at 110°C (383 K).
28. is an example of trihydric alcohol and is an example of dihydric alcohol.
 ISC Board-2011
29. Give balanced equation for the following reaction:
 1-butanol and hydrogen chloride
 ISC Board-2012
30. Name the type of isomerism exhibited by the following pairs of compounds.
 1-butanol and 2-methyl-1-propanol
 ISC Board-2013
31. Complete the following statements by selecting the correct alternative from the choices given below.
 The compound which is optically active
 (a) 1-butanol
 (b) 2-butanol
 (c) 1-propanol
 (d) 2-methyl-1 propanol
 ISC Board-2013
32. How can the following conversions be brought about?
 glycerol to formic acid
 ISC Board-2015
33. Glycerol (propane-1, 2, 3-triol) is more viscous than ethylene glycol (ethane-1, 2-diol). Explain.
 ISC Board-2016
34. Why do alcohols possess higher boiling points as compared to those of corresponding alkanes?
 ISC Board-2017
35. Explain the following by giving one example.
 Friedel-Crafts acetylation of anisole.
 Delhi 2011, 2010; All India 2009C
36. Give one chemical test to distinguish between the following pairs of compounds.
 (i) Phenol and benzoic acid.
 (ii) 1-propanol and 2-propanol
 Delhi 2010C, 2009C
37. Complete the following reactions equations:
 (i) 
 (ii) 
- Delhi 2009
38. Give reason for the following:
 (i) m-amino phenol is a stronger acid than o-amino phenol.
 (ii) Alcohols act as weak bases.
 Delhi 2008C
39. Describe the mechanism of alcohols reacting both as nucleophiles and as electrophiles in their reactions.
 Foreign 2008
40. Account for the following:
 (i) Propanol has higher boiling point than butane.

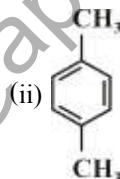
- (ii) Ortho-nitrophenol is more acidic than Ortho-methoxy phenol.
Delhi 2011, 2008C
41. Account for the following:
(i) The boiling point of alcohols decrease with increase in branching of the alkyl chain.
(ii) Phenol does not give protonation reaction readily.
Delhi 2011, All India 2008
42. How are the following conversions carried out
(i) benzyl chloride to benzyl alcohol?
(ii) methyl magnesium bromide to 2-methyl propane-2-ol?
Delhi 2010
43. Explain the following behaviours:
(i) Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses.
(ii) Ortho-nitrophenol is more acidic than ortho-methoxy phenol.
All India 2012
44. The C–O bond is much shorter in phenol than in ethanol. Give reason
Delhi 2012C
45. How could you convert ethanol to ethene?
All India 2011
46. Write the equations involved in the following reaction:
Reimer-Tiemann reactions
All India 2012
47. Write Reimer-Tiemann reaction giving an example.
All India 2011
48. o-nitrophenol has lower boiling point than p-nitrophenol. Explain.
Delhi 2013C
49. How would you obtain ethane-1, 2-diol from ethanol?
All India 2013C
50. Of the two hydroxy organic compounds ROH and R'OH, the first one is basic and other is acidic in behaviour. How is R different from R'?
Delhi 2013C
51. Which of the following isomers is more volatile: o-nitrophenol or p-nitrophenol?
All India 2014
52. Arrange the following compounds in the order of their increasing acid strength:

Odisha Board-2020
53. How are primary, secondary and tertiary alcohols identified by Victor Meyer's test?
Odisha Board-2023
54. How does Lucas reagent help in the distinction of primary secondary and tertiary alcohols.
Manipur Board-2018
55. What is power alcohol?
Manipur Board-2018
56. Write acidic order of primary, Secondary and Tertiary alcohols.
Haryana Board-2022
57. Arrange the following alcohols in the decreasing order of their boiling points:
Pentan – 1 – ol, 2 – Methylbutan – 2 – ol,
3 – Methylbutan – 2 – ol
Goa Board-2018
58. What is Lucas reagent ?
Chhattisgarh Board-2021
59. Alcohol and phenol are soluble in water. Why?
Chhattisgarh Board-2020
60. What happens when–
(a) Ethyl Alcohol is treated with Iodine in presence of Alkali.
(b) Chloroform is heated with a solution of Phenol and Sodium Hydroxide.
Uttarakhand Board-2019
61. Why is the boiling point of ethanol higher than its isomer methoxymethane ?
Manipur Board-2022
62. Convert the following:
(i) Benzene to Diphenyl
Haryana Board-2016
63. Give reason why phenols are acidic in nature.
Assam Board-2017
64. Propan-2-ol is more basic than propan-1-ol.
Assam Board-2015
65. Phenols are acidic in nature.
Assam Board-2015
66. Fill in the blanks:
(i) Oils and fats obtained from plants and animals are called
MP Board-2014
67. What are benzylic alcohol?
Nagaland Board-2020
68. Why are phenols more acidic than alcohol and water ?
Nagaland Board-2021
68. How do primary, secondary and tertiary alcohols differ towards oxidation reaction ?
Nagaland Board-2017
69. Give the name with chemical formula of the reagent used for the distinction between primary, secondary and tertiary alcohols.
Meghalaya Board-2018

Section-C : Short Answer

1. Write the mechanism of acid dehydration of ethanol to yield ethene.
Gujarat Board 2023 (July)
2. How can you convert the following :
(i) Sodium phenoxide to o-hydroxybenzoic acid
(ii) Acetone to propene
(iii) Phenol to chlorobenzene
CBSE-2020

3. Give reasons :
 (a) A decrease in temperature is observed on mixing ethanol and acetone.
 (b) Potassium chloride solution freezes at a lower temperature than water.
- CBSE-2019
4. (a) Write mechanism for the preparation of alcohols from alkenes (Acid catalysed hydration).
 (d) Give reasons:
 (d) o-nitrophenol has lower boiling point than p-nitrophenol.
 (d) Methyl phenyl ether cannot be prepared from bromobenzene.
- CBSE-2019
5. An organic compound (A) which has characteristic odour, on treatment with NaOH forms two compounds, (B) and (C). Compound (B) has molecular formula C_7H_8O , which on oxidation with CrO_3 gives back compound (A). Compound (C) is the sodium salt of the acid. Compound (C) when heated with soda lime yields an aromatic hydrocarbon (D). Identify the structures A, B, C and D.
- CBSE-2019
6. (i) Describe the mechanism of acid catalysed dehydration of ethanol to yield ethene.
 (ii) Describe the chemical test to distinguish between ethanol and phenol.
- All India 2010, 2009; Delhi 2008C
7. Explain the mechanism of the following reactions:
 (i) Addition of Grignard's reagent to the carbonyl group of compound forming an adduct followed by hydrolysis.
 (ii) Acid catalysed dehydration of an alcohol forming an alkene.
 (iii) Acid catalysed hydration of an alkene forming an alcohol.
- Delhi 2009
8. Explain the following observations:
 (i) The boiling point of ethanol is higher than of methoxy methane.
 (ii) Phenol is more acidic than ethanol.
 (iii) o and p-nitrophenols are more acidic than phenol.
- All India 2009
9. Name the reagents which are used in the following conversions:
 (i) A primary alcohol to an aldehyde
 (ii) Butan-2-one to butan-2-ol
 (iii) Phenol to 2, 4, 6-tribromophenol
- Delhi 2008
10. Account for following:
 (i) The boiling point of ethanol is higher than that of methanol.
 (ii) Phenol is a stronger acid than an alcohol.
 (iii) Propanol has higher boiling point than butane.
- Delhi 2011; All India 2009
11. Draw the structure and name the product formed if the following alcohols are oxidized. Assume that an excess of oxidising agent is used.
 (i) $CH_3CH_2CH_2CH_2OH$ (ii) 2-butanol
 (iii) 2-methyl-1-propanol
- Delhi 2012
12. Predict the products of the following reactions:
 (i) $CH_3 - CH = CH_2 \xrightarrow{(i) B_2H_6, (ii) 3H_2O/OH^-} ?$
 (ii) $C_6H_5OH \xrightarrow{Br_2 \text{ (aq)}} ?$
 (iii) $CH_3CH_2OH \xrightarrow{Cu/573K} ?$
- Foreign 2015
13. Arrange the following in increasing order of acidity:
- The diagram shows four chemical structures side-by-side. From left to right: 1. Benzyl alcohol: A benzene ring attached to a hydroxymethyl group (-CH₂OH). 2. 2-hydroxybenzyl alcohol: A benzene ring with a hydroxyl group (-OH) at position 2 and a methoxymethyl group (-O-CH₂CH₃) at position 4. 3. Toluene: A benzene ring with a methyl group (-CH₃) attached. 4. 2-nitrotoluene: A benzene ring with a nitro group (-NO₂) at position 2 and a methyl group (-CH₃) at position 1.
- Assam Board-2022
14. Arrange the following compounds in the increasing order of their boiling points:
 $CH_3 - CHO, CH_3 - CH_2 - OH, CH_3 - CH_2 - CH_3$
- Assam Board-2022
15. Explain :
 (i) Lucas test
 (ii) Cannizzaro reaction
- Gujarat Board-2021
16. Match the compounds in Column I with their functions in Column II correctly:
- | Column-I | Column-II |
|-------------------------------|---------------------------|
| (a) 1% solution of phenol | (i) Preservative |
| (b) Sodium hydrogen carbonate | (ii) Artificial Sweetener |
| (c) Aspartame | (iii) Antacid |
| (d) Sodium metabisulphite | (iv) Disinfectant |
- Odisha Board-2020
17. State Popott's rule.
- Tamil Nadu Board-2016
18. (i) Write structural formulae of products obtained in the following reactions :
 (p)
 (q)
 (ii) Mention one use of Lucas reagent.
- West Bengal Board-2019

19. (i) Explain the following with suitable examples:
 (a) Conversion of alkyl halide to ether.
 (b) Conversion of phenol to salicylic acid
 (ii) (a) How do you prepare carboxylic acid and alcohols from Grignard reagent? Give example.
 (b) What is carbylamine reaction? Give example.
- Andhra Pradesh Board-2020
20. Write balanced chemical equations for the following:
 (a) Action of sodium metal on ethanol
 (b) Action of zinc dust on phenol
- Maharashtra board-2019
21. Arrange the compounds of the following groups in the increasing order of their boiling points :
 Penten-1-ol, Butan-1-ol, Butan-2-ol, Propenol-1
- Chhattisgarh Board-2022
22. How will Primary, Secondary and Tertiary alcohols be distinguished by Lucas test? Explain.
- Chhattisgarh Board-2021
23. Lucas test is used to identify primary, secondary and tertiary alcohols.
 (a) Explain the process.
 (b) Name the reagents used in the test.
- Kerala Board-2018
24. Give chemical test to distinguish:
 (i) Ethyl alcohol and sec-propyl alcohol
 (ii) Acetaldehyde and acetic acid
- ISC Board-2017
25. How can the following conversions be brought about:
 (i) Why do alcohols possess higher boiling points as compared to those of corresponding alkanes?
- ISC Board-2017
26. (i) Alcohols and phenols have higher boiling points. Why ?
 (ii) What is aspirin? How is it prepared from salicylic acid?
- Kerala Board-2022
27. Name any two tests to distinguish Alcohol from Phenol.
- Haryana Board-2017
28. p-Nitrophenol is more acidic than phenol explain why?
- Haryana Board-2017
29. Discuss the acidic nature of phenols.
- Haryana Board-2017
30. Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses.
- Haryana Board-2016
31. Alcohols are compounds with general formula R - OH.
 (a) Alcohols are soluble in water. What is the reason?
- (b) (i) Explain a method for manufacture of Ethanol
 (ii) How will you convert phenol to benzene?
- Kerala Board-2015
32. Compare the boiling points of Primary, Secondary and Tertiary amines.
- Haryana Board-2016
33. Give a simple chemical test to distinguish between Primary, secondary and Tertiary alcohols.
- Haryana Board-2016
34. Give chemical test to distinguish between Phenol and Benzoic acid.
- Haryana Board-2016
35. Phenol is more acidic than Ethanol, explain.
- Haryana Board-2018
36. Why phenol are more acidic than alcohol? Explain.
- Rajasthan Board-2019
37. Arrange the following alcohols in increasing order of their reactivity towards esterification reaction.
- $\text{CH}_3 — \text{CH}_2 — \text{OH}, (\text{CH}_3)_2\text{CH} — \text{OH}, (\text{CH}_3)_3\text{C} — \text{OH}$
- Rajasthan Board-2019
38. Why the boiling points of alcohols are higher than hydrocarbons and ethers of comparable molecular mass? Explain.
- Rajasthan Board-2019
39. Arrange the following alcohols in increasing order of their reactivity towards dehydration reaction
- $\text{CH}_3 — \text{CH}_2 — \text{OH}(\text{CH}_3)_2\text{CH} — \text{OH}(\text{CH}_3)_3\text{C} — \text{OH}$
- Rajasthan Board-2019
40. Draw the resonating structures of phenoxide ion.
- Rajasthan Board-2019
41. The mixture of alcohol and Ether, used in place of petrol, is known as?
- Rajasthan Board-2018
42. Explain denaturation of alcohol.
- Rajasthan Board-2017
43. Explain why hydroxyl group attached to an aromatic ring is more acidic than the one in which hydroxyl group is attached to an alkyl group?
- Rajasthan Board-2016
44. Write the resonance structures of phenol.
- Rajasthan Board-2013
45. Write the equations for Laderer-Manasse reaction.
- Rajasthan Board-2010
46. Given the names of components of power alcohol and its one use.
- Rajasthan Board-2010
47. Write one test to differentiate ethanol and phenol.
- Rajasthan Board-2010
48. Write the Victor Meyer's test for secondary alcohol.
- Tamilnadu Board, Sep.-2016

49. Why is glycol more viscous than ethanol?
Tamilnadu Board, March-2016
50. Arrange the following compounds in increasing order of their boiling points:
 CH_3CHO , $\text{CH}_3\text{CH}_2\text{OH}$, $\text{CH}_3\text{-O-CH}_3$,
 $\text{CH}_3\text{CH}_2\text{CH}_3$.
Assam Board-2018
51. Arrange the following compounds in increasing order of reactivity towards Lucas reagent :
 $\text{CH}_3\text{CH}_2\text{OH}$, $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$,
 $(\text{CH}_3)_3\text{C(OH)}$.
Assam Board-2012
52. Give the reasons :
 (i) Boiling points of alcohols are higher than ethers.
 (ii) Pure phenol is a colourless solid but it converted into pink after some time by placing open in the air. Give chemical reaction.
MP Board-2018
53. Explain the following :
 (i) Lucas reagent
 (ii) Reimer-Tiemann reaction.
MP Board-2017
54. Differentiate between phenol and alcohol. (any four)
MP Board-2017
55. Write any four differences between alcohol and phenol.
MP Board-2015
56. (i) Boiling point of alcohol is higher than its corresponding alkane. Why?
 (ii) Phenols are more acidic than alcohols. Why?
MP Board-2015
57. Differentiate between Primary, Secondary and Tertiary alcohol by Victor Meyer method.
MP Board-2014
58. Ethyl alcohol and Phenol both contain OH group. Why Phenol is acidic and alcohol is neutral in nature? Give reason
MP Board-2013
59. What is Lucas reagent? Distinguish primary, secondary and tertiary alcohol using Lucas reagent.
MP Board-2013
3. (a) Arrange the following in order of their increasing stability :
 $\text{RCH}_2^+, \text{R}_2\text{CH}^+, \text{R}_3\text{C}^+$
 Justify your answer.
- (b) How will you distinguish between primary, secondary and tertiary alcohols ?
NIOS Board-2021
4. a) What is the effect of
 i) Electron with drawing group on acidity of phenols.
 ii) Electron donating group on acidity of alcohols.
 iii) Boiling point of alcohols on increasing number of carbon atoms,
 b) Give equation for Williamson's ether synthesis.
Karnataka Board-2014
5. (a) Write down the names of the following organic compounds:
 (i) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} - \text{CH} - \text{CH}_3$
 $\quad \quad \quad \quad \quad | \quad \quad | \quad \quad |$
 $\quad \quad \quad \quad \quad \text{C}_2\text{H}_5 \quad \text{CH}_3$
 (ii) 
- (b) How will you confirm the presence of nitrogen in an organic compound?
 (c) What is Lucas test ? What is its use ?
NIOS Board-2016
6. What are primary, secondary and tertiary alcohols?
Haryana Board-2017
7. Phenol is more acidic than ethanol. Explain.
Haryana Board-2016
8. Difference between primary, secondary and tertiary alcohol through Victor Meyer's method only Equations.
MP Board-2016
9. Answer the following questions : [Either (a) and (b) or only (c)]
 (a) What will happen when vapour of 3° alcohol is passed over heated copper at 573K?
 (b) How to get synthesize aspirin from salicylic acid?
 (c) How will you convert the following?
 (i) Acetaldehyde to isopropanol
 (ii) Phenol to 2, 4, 6 tribromophenol
 (iii) Ethanol to chloroform
Assam Board-2023

Section-E : Long Answer

1. How Phenol is identified by dye test? Give equation.
Tamil Nadu Board-2011
2. An organic compound 'A' having molecular formula C_3H_6 on treatment with aqueous H_2SO_4 gave 'B' which on treatment with Lucas reagent gives 'C'. The compound 'C' on the treatment with ethanol and KOH gives back on compound 'A'. Identify A, B, & C and write the chemical equations involved.
NIOS Board-2018

E. Ethers

Section-A : Multiple Choice Questions

1. With alcoide ion, which compound will give best result in Williamson synthesis reaction?

- (a) $\text{CH}_3\text{CH}_2\text{Cl}$ (b) $(\text{CH}_3)_2\text{CHCl}$
(c) $(\text{CH}_3)_3\text{CCl}$ (d) $(\text{CH}_3\text{CH}_2)_2\text{CHCl}$

Gujrat Borad-2022 (July)

Ans. (a)

2. Williamson's method is a very useful method for the preparation of ethers. However it will not work in the preparation of-

- (a) $(\text{CH}_3)_2\text{O}$ (b) $\text{CH}_3\text{OC}_2\text{H}_5$
(c) $\text{C}_6\text{H}_5\text{OCH}_2\text{CH}_3$ (d) $\text{C}_6\text{H}_5\text{OC}_6\text{H}_5$

Manipur Board 2023

Ans. (a)

3. Assertion (A) : The C-O-C bond angle in ethers is slightly less than tetrahedral angle.

Reason (R) : Due to the repulsive interaction between the two alkyl groups in ethers.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is correct, but Reason (R) is wrong statement.
(d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

4. Assertion (A) : $(\text{CH}_3)_3\text{C}-\text{O}-\text{CH}_3$ gives $(\text{CH}_3)_3\text{C}-\text{I}$ and CH_3OH on treatment with HI.

Reason (R) : The reaction occurs by $\text{S}_{\text{N}}1$ mechanism.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A)..
(b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is correct, but Reason (R) is wrong statement.
(d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

5. In reaction, $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + 4\text{H} \xrightarrow{\text{Red P+HI}} 2\text{X} + \text{H}_2\text{O}$ the X is—

- (a) Ethylene (b) Ethane
(c) Propane (d) Butane

Uttarakhand Board-2020

Ans. (b)

6. Ethyl ether can be decomposed with:

- (a) HI (b) KMnO_4
(c) NaOH (d) H_2O

Tamil Nadu Board-2015

Ans. (a)

7. Number of ether isomers possible for the molecular formula $\text{C}_4\text{H}_{10}\text{O}$ is

- (a) one (b) two
(c) three (d) four

Tamil Nadu Board-2011

Ans. (c)

8. When ether is exposed to air for some time, an explosive substance produced is

- (a) Peroxide (b) Oxide
(c) TNT (d) superoxide

Tamil Nadu Board-2011

Ans. (a)

9. Williamson's synthesis is an example of

- (a) nucleophilic addition
(b) electrophilic addition
(c) electrophilic substitution
(d) nucleophilic substitution

Tamil Nadu Board-2011

Ans. (d)

10. Diethyl ether behaves as a

- (a) Lewis acid
(b) Lewis base
(c) Neutral compound
(d) Brønsted acid

Tamil Nadu Board-2011

Ans. (b)

11. Diethyl ether is used as a solvent for:

- (a) Lucas reagent (b) Fenton's reagent
(c) Tollen's reagent (d) Grignard reagent

Tamil Nadu Board-2016

Ans. (d)

12. According to Lewis concept of acids and bases ethers are:

- (a) Neutral (b) Acidic
(c) Basic (d) Amphoteric

Tamil Nadu Board-2016

Ans. (c)

13. Which one of the following is a simple ether?

- (a) $\text{C}_2\text{H}_5-\text{O-CH}_3$ (b) $\text{C}_3\text{H}_7-\text{O-C}_2\text{H}_5$
(c) $\text{CH}_3-\text{O-C}_6\text{H}_5$ (d) $\text{C}_2\text{H}_5-\text{O-C}_2\text{H}_5$

Tamil Nadu Board-2018

Ans. (d)

14. The formation of oxonium salt when ether reacts with strong mineral acids is called:

- (a) Deprotonation (b) Electronation
(c) Dehydration (d) Protonation

Tamil Nadu Board-2018

Ans. (d)

15. What will be the C – O – C bond angle in ethoxy ethane?

- (a) 109° (b) 111.7°
(c) 108° (d) 108.5°

Gujarat Board-2019

Ans. (b)

16. Ethanoyl chloride + Ethanol → A

- 'A' is
(a) Methyl ethanoate
(b) Ethyl ethanoate
(c) Ethyl methanoate
(d) None of these

Jharkhand Board-2018

Ans. (b)

17. Molecular formula of Ethers is:

- (a) $C_nH_{2n+1}O$ (b) $C_nH_{2n}O$
(c) $C_nH_{2n+2}O$ (d) None of these

Haryana Board-2017

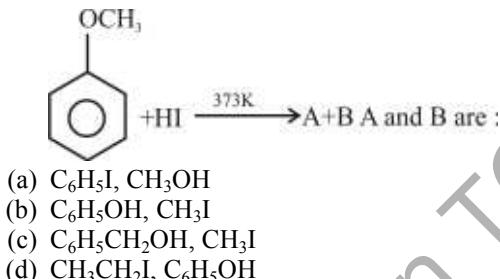
Ans. (c)

18. Anisole  with HI at 373 K temperature will give:
(a) $C_6H_5I + CH_3OH$
(b) $C_6H_5OH + CH_3I$
(c) $C_6H_5CH_2OH + CH_3I$
(d) $CH_3CH_2I + C_6H_5OH$

Haryana Board-2018

Ans. (b)

19. In the reaction



Haryana Board-2018

Ans. (b)

20. (i) Williamson Synthesis is used to prepare:

- (a) Alcohol (b) Amine
(c) Ketone (d) Ether

Haryana Board-2018

Ans. (d)

21. Write IUPAC name of Diethyl ether.

Rajasthan Board-2019

22. Diethyl ether can be decomposed with:

- (a) HI (b) $KMnO_4$
(c) NaOH (d) H_2O

Tamilnadu Board, Sep.-2016

Ans. (d)

23. The number of ether isomers possible for the molecular formula $C_5H_{12}O$:

- (a) 5 (b) 6
(c) 4 (d) 7

Tamilnadu Board, March-2016

Ans. (b)

24. When ether is exposed to air for sometime an explosive substance produced is:

- (a) Peroxide

- (b) Oxide

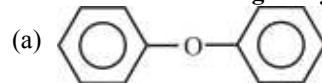
- (c) TNT

- (d) Superoxide

Tamilnadu Board, March-2016

Ans. (d)

25. Which of the following is asymmetric ether?



- (b) $C_2H_5 - O - C_2H_5$

- (c) $CH_3 - O - CH_3$

- (d) $CH_3 - O - C_2H_5$

Gujarat Board-2017

Ans.(d)

26. Which of the following is symmetrical ether?

- (a) $CH_3 - O - C_2H_5$

- (b) $C_6H_5 - O - C_6H_5$

- (c) $C_6H_5 - O - C_2H_5$

- (d) $C_2C_2H_5 - O - C_2H_5$

Gujarat Board-2018

Ans. (b)

27. By which of the following reaction ether compound will be obtained easily?

- (a) $(CH_3)_3 \cdot C \cdot ONa + CH_3Cl \rightarrow$

- (b) $(CH_3)_3 \cdot C \cdot ONa + (CH_3)_2CH \cdot Cl \rightarrow$

- (c) $(CH_3)_3 \cdot C \cdot ONa + (CH_3)_3 \cdot C \cdot Cl \rightarrow$

- (d) $CH_3 - \begin{matrix} C \\ | \\ CH_3 \end{matrix} - ONa + CH_3 - \begin{matrix} CH \\ | \\ Cl \end{matrix} - CH_3 \rightarrow$

Gujarat Board-2019

Ans. (a)

28. Which products obtained when one mole of ether ($R-O-R$) is reacted with one mole of HX ?

- (a) Only $R-X$

- (b) $R-X + R-OH$

- (c) Only $R-OH$

- (d) $2R - X + H_2O$

Gujarat Board-2020

Explain : (b)

Section-B : Very Short Answer

1. In Williamson synthesis the _____ reacts with sodium alkoxide and give dialkyl ether.

Rajasthan Board 2023

2. How will you bring about the following conversion?

Diethyl ether to ethanol.

ISC Board-2008

3. Give the balanced equation for the following reaction:

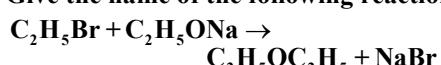
Chlorine is passed through diethyl ether.

ISC Board-2010

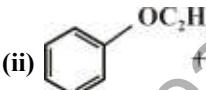
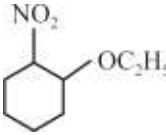
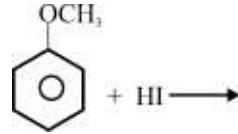
4. and are functional isomers:

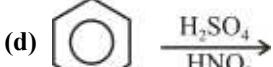
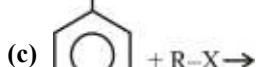
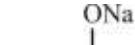
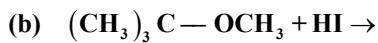
ISC Board-2009

5. Give the name of the following reaction.



ISC Board-2009

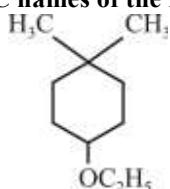
6. Write the structures of the isomeric ethers with the formula $C_4H_{10}O$. ISC Board-2011
- Marks Question
7. Give the chemical test to distinguish: dimethyl ether and ethyl alcohol. ISC Board-2016
8. Write the structure of three ethers with molecular formula $C_4H_{10}O$. ISC Board-2016
9. Give the balanced equation for the following reaction: Diethyl ether with phosphorus pentachloride. ISC Board-2016
10. Give the chemical equation for the following : Williamson's synthesis ISC Board-2015
11. Give the balanced equation for the following reaction: Sodium ethoxide is treated with ethyl bromide. ISC Board-2014
12. How will you bring about the following conversion? Diethyl ether to ethanol ISC Board-2008
13. Name the two organic compounds which have the same molecular formula C_2H_6O Will they react with PCl_5 ? If they react, what are the products formed? ISC Board-2017
14. Why is the preparation of ether by acid catalysed dehydration of secondary alcohol not a suitable method? All India 2008C
15. Give mechanism of preparation of ethoxy ethane from ethanol. Delhi 2013C
16. How is 1-propoxy propane synthesized from propan-1-ol? Delhi 2010
17. State the products of the following reactions:
- $CH_3CH_2CH_2OCH_3 + HBr \longrightarrow$
 -  + $HBr \longrightarrow$
 - $(CH_3)_3C-OC_2H_5 \xrightarrow{HI} \longrightarrow$
- All India 2012C
18. Illustrate the following reaction by giving a chemical equation:
Williamson's synthesis Foreign 2012
- Delhi 2010; All India 2010;
2009C Foreign 2010, 2009
19. Phenyl methyl ether reacts with HI to give phenol and methyl iodide and not iodobenzene and methyl alcohol. Why? Delhi 2010C
20. Write the equation involved in the reaction Williamson's ether synthesis. All India 2013
21. Write the IUPAC name of the following All India 2012C
- 
22. Name the alcohol that is used to make the following ester: All India 2014C
- $CH_3-C(=O)-O-CH(CH_3)-CH_3$
23. Answer the following questions :
(a) Etherification does not take place between ethyl alcohol and excess H_2SO_4 at $170^\circ C$. Explain. Odisha Board-2017
24. How can you prepare diethyl ether from ethyl chloride? Odisha Board-2023
25. How anisole reacts with bromine in ethanoic acid? Write the chemical equation for the reaction. Karnataka Board-2018
26. How anisole reacts with acetyl chloride [CH_3COCl] in the presence of anhydrous $AlCl_3$? Write the chemical equation for the reaction. Karnataka Board-2017
27. a) Write the IUPAC name of major product formed in Friedel-Crafts acylation of anisole.
b) Complete the reaction Karnataka Board-2015
- 
28. What are ethers ? How are they classified ? Maharashtra board-2019
29. $CH_3OC_2H_5 + HI \xrightarrow{\text{EXCESS}} A + B$
Give structures of A and B products. Haryana Board-2016
30. Predict the products obtained by the reaction of 2- methoxy -2- methylpropane with HI Kerala Board-2019
31. Write the structure of 2-Ethoxy-1, dimethyl cyclohexane. Haryana Board-2016
32. Why Ether is insoluble in water? [1] Uttarakhand Board-2019
33. Completes the reaction:
 $C_2H_5OC_2H_5 + 2HI \xrightarrow{373K} \longrightarrow$ Haryana Board-2018
34. Complete the following chemical reactions:
- $CH_3CH_2OH \xrightarrow[413K]{H_2SO_4} \longrightarrow$



35. What is the major product when ethanol is treated with conc. H_2SO_4 at 413 K? Rajasthan Board-2016

36. Write the IUPAC name and structural formula of methyl n-propyl ether. Rajasthan Board-2013

37. Write IUPAC names of the following ether.



Assam Board-2019

38. Complete the following reaction-



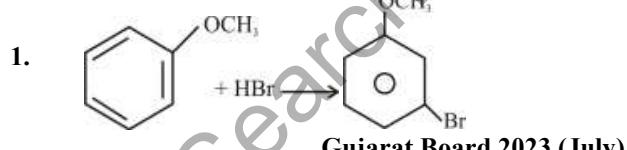
Assam Board-2016

39. Explain why alcohols are more soluble in water compared to ethers. Assam Board-2016

40. Ethers have lower boiling points than alcohols. Assam Board-2015

41. Write the preparation of ether by Williamson synthesis. Nagaland Board-2021

Section-C : Short Answer

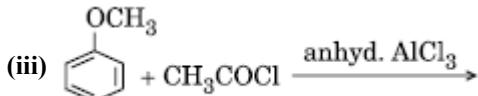
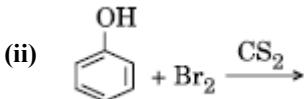
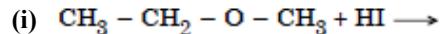


2. How will you obtain the following :

- (i) Diethyl ether from Sodium ethoxide.

UP Board 2023

3. Write the products of the following reactions:



CBSE-2019

4. Explain electrophilic substitution reaction of Anisol.

Gujarat Board-2016

5. Give any three methods of preparing anisole? Tamil Nadu Board-2015

6. Distinguish aliphatic and aromatic ethers.

Tamil Nadu Board-2011

7. Explain why ethers (a) act as polar solvents and (b) have lower boiling points as compared to alcohols having similar molecular masses.

NIOS Board-2015

8. Write chemical reactions of following reagents on methoxyethane :

(a) hot HI

(b) PCl_5

(c) dilute H_2SO_4

Maharashtra board-2022

9. Explain following reactions :

(i) Riemer-Tieman reaction.

(ii) Williamson's synthesis.

Kerala Board-2021

10. What happens when (give only equation)-

(i) diethyl ether heated with conc HI

(ii) Reduction of carboxylic acid with LiAlH_4 .

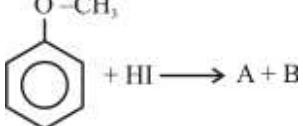
Chhattisgarh Board-2021

11. Give balanced equation for the following name reactions:

(i) Williamson's synthesis

ISC Board-2017

12. (i) Identify A and B in the following reaction

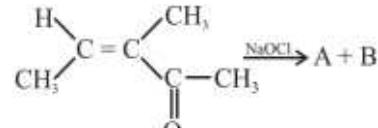


- (ii) What is meant by hydroboration-oxidation reaction? Illustrate it with an example.

Kerala Board-2022

13. Give reason for the higher boiling point of ethanol in comparison to methoxymethane.

Assam Board-2014



Give structures of A and B products.

Haryana Board-2016

15. How do you account for the miscibility of Ethoxy ethane in water?

Haryana Board-2018

16. What happens when the vapour of diethyl ether is passed over alumina at 653K temperature? Give chemical reaction.

Rajasthan Board-2020

17. What happens when diethyl ether reacts with chlorine in presence of sunlight? Give chemical reaction.

Rajasthan Board-2020

18. Give equations for preparation of ether by the following reactions:
 (i) dehydration of alcohols
 (ii) Williamson synthesis
- Rajasthan Board-2013
19. Give the names of main components and one use of Natalite.
- Rajasthan Board-2010
20. Explain why alkoxy group ($-OR$) is ortho, para directing and activates the aromatic ring towards electrophilic substitution.
- Assam Board-2018
21. Complete the following reaction and name the product.
- $$\text{CH}_3 - \text{CH} = \text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{H}^+}$$
- Assam Board-2017
22. Give chemical equations of the following conversions:
 (a) Diethyl ether from Ethanol
 (b) Ethanol from Diethyl Ether
- MP Board-2012
23. Write the mechanism of the reaction of HI with methoxyethane.
- Assam Board-2023

Section-D : Case Based Study

24. (a) An organic compound 'A' having molecular formula $\text{C}_6\text{H}_6\text{O}$ gives a characteristic colour with FeCl_3 solution. When 'A' is treated with CO_2 and NaOH at 400 K under pressure, compound 'B' is obtained. The compound 'B' upon acidification gives compound 'C' which reacts with acetylchloride to form 'D' which is a popular pain killer. Deduce the structures of A,B,C and D.
 (b) Predict the products of the following reaction
- $$\text{CH}_3\text{CH}_2\text{CH}_2 - \text{O} - \text{CH}_3 + \text{HBr} \xrightarrow{373\text{K}}$$
- Manipur Board 2020
25. Compound, A ($\text{C}_2\text{H}_4\text{O}$) is produced by the partial oxidation of ethanol with PCC. It reacts with HCN to produce compound B which on hydrolysis forms an optically active compound, C Identify A, B, C and write the reactions.
- Manipur Board 2023
26. (a) An organic compound (A) of molecular formula $\text{C}_6\text{H}_6\text{O}$ gives violet colour with neutral ferric chloride. Compound (A) when heated with zinc dust gives a hydrocarbon (B). Also compound (A) reacts with phthalic anhydride and conc. H_2SO_4 to give compound (C) of molecular formula $\text{C}_{20}\text{H}_{14}\text{O}_4$ Identify (A), (B) and (C) Explain the reactions.
- Tamil Nadu Board-2018

Section-E : Long Answer

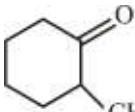
1. Write the names of reagents and equations for the preparation of following ethers by Williamson's synthesis:
 (i) 1-propoxy propane
 (ii) Ethoxy benzene
 (iii) 2-methoxy-2-methyl propane
- Gujarat Board-2021
2. How does diethyl ether react with the following reagents?
 (a) Oxygen – long contact
 (b) PCl_5
 (c) Dilute H_2SO_4
- Tamil Nadu Board-2011
3. a) Explain the mechanism of acid catalysed dehydration of ethanol to ethane.
 b) How do you prepare methoxy ethane by Williamson's ether synthesis?
- Karnataka Board-2019
4. a) i) Identify 'A' and 'B' in the following equation

$$\text{CH}_3 - \text{CH} = \text{CH}_2 \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \text{A} \xrightarrow{\text{CrO}_3} \text{B}$$

 ii) What is Lucas reagent?
 b) Explain Williamson Ether synthesis. (3 +2)
- Karnataka Board-2016
5. a) Explain the mechanism of acid catalyzed dehydration of ethanol to ethane.
 b) Write general equation for preparation of ether by Williamson synthesis.
 c) Among alcohols and phenols which one is more acidic?
- Karnataka Board-2019
6. Write the resonance structures of alkoxy benzene.
- Rajasthan Board-2013
7. Give the equation obtaining the following from diethyl ether:
 (a) Hydroperoxy diethyl ether
 (b) Perchlorodiethyl ether
- Rajasthan Board-2010
8. How does diethyl ether reacts with the following reagents?
 (i) Con. H_2SO_4
 (ii) dil. H_2SO_4
 (iii) HI
- Tamilnadu Board, Sep.-2016
9. How are the following reactions effected?
 (i) diethyl ether with grignard reagent
 (ii) diethyl ether with mineral acid
 (iii) ethyl methyl ether with excess hot Conc. HI acid.
- Tamilnadu Board, March-2016
10. Explain Williamson synthesis to prepare ether and state the limitations of the process. State all reactions.
- Gujarat Board-2020
11. Give reason for the higher boiling point of ethanol in comparison to methoxymethane.
- Assam Board-2019

22. Write the structure of p-methylbenzaldehyde.
Delhi 2014, Delhi 2013
23. Draw a pair of isomers for $C_4H_{10}O$ and name the type of isomerism
ISC Board-2011
24. andare functional isomers.
ISC Board-2009
25. Write the IUPAC name of the following compound:

$$\begin{array}{c} CH_3 - C \backslash H - CHO \\ | \\ OCH_3 \end{array}$$

Odisha Board-2017
26. Give the IUPAC name of CH_3CHO .
Karnataka Board-2014
- 27.
- 
- CH_3 Write its IUPAC name.
Haryana Board-2022
28. is the IUPAC name of the compound $CH_3CH(CH_3)CH_2CH_2CHO$.
Haryana Board-2021
29. Give the IUPAC name of $CH_3 - C = CH_3$.
Karnataka Board-2020
30. Write the I.U.P.A.C name of $CH_2 = CH - CHO$.
Karnataka Board-2017
31. Draw structures of the following compounds:
(i) Chloric acid
(ii) Peroxy disulphuric acid
Maharashtra board-2023
32. What is the IUPAC name of CH_3COCH_3 ?
Chhattisgarh Board-2022
33. Write the IUPAC names of the following:
(i) $CH_3CH-(CH_3)-CHO$
(ii) $C_6H_5-CH_2-CHO$
Haryana Board-2017
34. Write the IUPAC names of following compounds:
(i) $CH_3-CHOH-CH_2-CHOH-CH_3$
(ii) $C_6H_5-O-C_6H_5$
Haryana Board-2017
35. Write IUPAC name and chemical formula of Acetone.
Rajasthan Board-2018
36. Give the structural formulae and IUPAC names of the following compounds:
(a) Formaldehyde (b) Acetone
Rajasthan Board-2013
37. Give the IUPAC name of $(CH_3)_3COCH_3$
J & K Board-2021
38. Write the IUPAC name of $(CH_3)_2CHCHO$
Nagaland Board-2018
39. What is the IUPAC name of $CH_3CH_2CHClCHO$?

$$\begin{array}{c} | \\ Cl \end{array}$$

Nagaland Board-2017

Section-C : Short Answer

1. Give the IUPAC names of:
(i) $\begin{array}{c} CH_3 - CH - C - CH - OCH_2CH_3 \text{ and} \\ | \quad || \quad | \\ OCH_3 \quad O \quad CH_3 \end{array}$
Tamil Nadu Board-2015
- (ii) $\begin{array}{c} CH_3 - CO - CH - CH_2 - CH_2 - Cl \\ | \\ C_2H_5 \end{array}$
2. (a) Write structural formula of Diethyl ketone.
(b) Explain mechanism of Kolbe electrolysis.
Rajasthan Board-2019
3. Draw orbital diagram for the formation of carbonyl group?
Rajasthan Board-2016
4. (a) Give one chemical test to distinguish between the following pair:
Pentan-2-one and Pentan-3-one
(b) Identify A and B:
 $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow[\Delta]{P_2O_5} B$
Assam Board-2013
5. Differentiate between molarity and molality (any three).
MP Board-2017

Section-E : Long Answer

1. (a) Write the IUPAC name of the following compound :

$$\begin{array}{c} CH_3 \\ | \\ CH_3 - CH - CH - COOH \\ | \\ Cl \end{array}$$
- (b) Write the structure of the main product when aniline reacts with
(i) aqueous solution of bromine and (ii) conc. H_2SO_4 .
(c) What are the products of hydrolysis of sucrose?
NIOS Board-2014

B. Preparation of Aldehydes and Ketones

Section-A : Multiple Choice Questions

1. A carbonyl compound with molecular weight 86, does not reduce Fehling's solution but forms crystalline bisulphite derivative and given iodoform test. The possible compounds are
(a) 2 - pentanone and 3 - pentanone
(b) 2 - pentanone and 3 - methyl- 2- butanone
(c) 2 - pentanone and pentanal
(d) 3 - pentanone and 3- methyl -2 butanone.
Manipur Board-2017

Ans. (b)

21. Complete the following reactions:
 (i) $\text{C}_2\text{H}_4 + \text{O}_2 \rightarrow ?$ Assam Board-2020
22. Identify the compounds A and B in the following sequence of reactions:

$$\text{CH}_3 - \underset{\parallel}{\text{C}} - \text{OH} \xrightarrow{\text{SOCl}_2} \text{A} \xrightarrow[\text{H}_2]{\text{Pd/BaSO}_4/\text{S}} \text{B}$$
 Meghalaya Board-2021
- Section-C : Short Answer**
1. Write the chemical equation involved in Rosenmund's reduction. Gujarat Board 2023 (July)
2. Write silver mirror test for identification of Aldehyde. MP Board 2020
3. Explain following reactions :
 (a) Etards reactions MP Board 2020
4. Gatterman - Koch reaction MP Board 2020
5. Aldol condensation. MP Board 2020
6. Explain following reactions :
 (a) Remer-Timman reaction
 (b) Kolbe reaction. MP Board 2020
7. Write short notes on the following :
 (i) Etard reaction UP Board 2023
8. Benzyl alcohol from Benzyl chloride. UP Board 2023
9. Write short note on Gattermann-Koch reaction.
 (or)
 (i) $\text{CH}_3\text{MgBr} + \text{CO}_2 \xrightarrow{\text{dry ether}} \text{x} \xrightarrow{+\text{H}^+\text{O}} \text{y}$
 Write chemical formula and name of x and y in above chemical sequence.
 (ii) Write short note on Rosenmund reduction. Rajasthan Board 2023
10. An organic compound A (molecular formula C_2H_5) does not react with Tollen's reagent but on reduction gives compound B ($\text{C}_3\text{H}_5\text{O}$). Compound B, on treatment with HBr, gives Bromide C, which on treatment with alcoholic KOH gives bromide D, which on treatment with alcoholic KOH gives Alkene E (C_3H_5). Identify compounds A, B, C and D with essential chemical reactions. Uttarakhand Board 2023
11. how can acetophenone be prepared by Friedel-Crafts reactions? Tamil Nadu Board-2011
- 12.(i) Suggest a method of preparation of benzaldehyde from toluene.
 (ii) Aldehydes and ketones differ in their chemical reactions. How do they react with the following?
 (a) Tollen's reagent
 (b) Alcohol. MP Board-2014
- (iii) How will you convert propanoic acid into the following compounds?
 (a) Ethane
 (b) Butane. Kerala Board-2013
13. (i) The test to distinguish Propanal and Propanone is
 (A) Tollens' test
 (B) Lucas test
 (C) Hinsberg test
 (D) Bromine-Water test
 (ii) Which is more reactive towards nucleophilic addition, CH_3CHO or $\text{C}_6\text{H}_5\text{CHO}$? Give reason. Kerala Board-2021
14. Identify the compounds A, B and C:
 (i) $\text{H} - \text{C} \equiv \text{C} - \text{H} \xrightarrow[\text{dilH}_2\text{SO}_4 + \text{HgSO}_4]{\text{H}_2\text{O}} \text{A} \xrightarrow[\text{[Ni]}}{\text{H}_2} \text{B} \xrightarrow[\text{concH}_2\text{SO}_4]{140^\circ\text{C}} \text{C}$ ISC Board-2017
15. Give two methods of preparation of Ketones and write the chemical reactions. Haryana Board-2017
16. How will you prepare Aldehyde from:
 (a) Alcohol
 (b) $(\text{RCOO})_2\text{Ca}$
 (c) Alkyne Haryana Board-2017
17. Draw the polar structure of carbonyl group. Rajasthan Board-2010
18. Describe methods for the preparation of hydrocarbon by the reduction of aldehyde. Gujarat Board-2017
19. Give a general method of preparation of aldehyde, using a selective oxidising agent. Assam Board-2017
20. What happens when $\text{CH}_3 - \underset{\text{CH}_3}{\text{C}} = \text{CH}_2$ is ozonolysed? Assam Board-2013
21. How will you obtain following compounds from benzaldehyde?
 (Give equations only)
 (i) Cinnamaldehyde
 (ii) Benzoin
 (iii) Cinnamic acid
 (iv) Benzoil chloride MP Board-2014
22. Describe the method for the preparation of acetone in laboratory and give the chemical equation with labelled diagram.

Section-D : Case Based Study

1. An organic compound with the molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation it gives 1,2-benzenedicarboxylic acid. Identify the compound and write down its above chemical reactions.

2. Write Kolbe and Reimer Tiemann reaction of phenol.

Gujarat Board-2022 (July)

Section-E : Long Answer

1. (a) How is benzoyl chloride converted into benzaldehyde? Write the equation and name the equation.
 (b) Write a general equation for the formation of carboxylic acid from Grignard reagent.
- Karnataka Board-2020
2. (i) Convert Benzene to acetophenone.
 (ii) Convert Propanone to Propene
 (iii) Convert Ethanol to 3-Hydroxybutanal.
- Haryana Board-2021
3. (i) Draw structure of 4-Oxopentanal.
 (ii) Describe Hell – Volhard – Zelinsky reaction.
 (iii) Describe Aldol condensation reaction.
- Haryana Board-2021
4. How is Acetone prepared from
 (i) Acid chloride
 (ii) Alkynes
 (iii) Calcium acetate
- What happens when acetone is treated with
 (i) Sodium bisulphite
 (ii) Grignards reagent

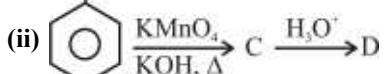
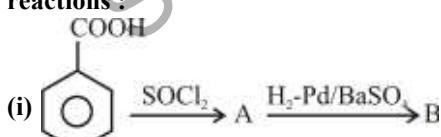
J&K Board-2019

5. (a) Write the structure of Phenylmethanamine.
 (b) Write chemical equation for the following:
 (i) Gatterman - Koch formylation
 (ii) Rosenmund reduction
 (iii) Fischer esterification
 (iv) Hell - Volhard – Zelinsky reaction
- Maharashtra board-2019

6. Write three different equations for preparation of corresponding alkane from acetone.

Gujarat Board-2019

- 7.(a) Arrange the following in increasing order of acidic strength :
 $CICH_2COOH$, CF_3COOH , $HCOOH$,
 CCl_3COOH
- (b) Identify the product A, B, C and D in the given reactions :



- (c) How will you bring about the following conversions?

- (i) Ethyl cyanide to 1-phenyl propanone
 (ii) Ethanol to 2-aminoethanoic acid

Meghalaya Board-2019

C. Reaction of Aldehydes and Ketones

Section-A : Multiple Choice Questions

1. Which of the following is Cannizzaro reaction?
 (a) $2CH_3CHO + dil.NaOH \longrightarrow$
 (b) $2HCHO + conc. NaOH \xrightarrow{\Delta} \longrightarrow$
 (c) $2CH_3Cl + 2Na \xrightarrow{ether} \longrightarrow$
 (d) $2CH_3OH + Na \longrightarrow$

Gujarat Board-2022 (July)

Ans. (b)

2. Which will be the final product by reaction of formaldehyde with ethyl magnesium bromide?
 (a) propane-1-ol
 (b) propane-2-ol
 (c) butane-2-ol
 (d) 2-methyl propane-2-ol

Gujarat Board-2022 (July)

Ans. (a)

3. Assertion (A) : Benzaldehyde is less reactive than ethanal towards nucleophilic addition reactions.
 Reason (R) : Ethanal is more sterically hindered.
 (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is wrong statement.
 (d) Assertion (A) is wrong, but Reason (R) is correct statement.

CBSE-2020

Ans. (b)

4. Assertion (A) : Reactivity of ketones is more than aldehydes.
 Reason (R) : The carbonyl carbon of ketones is less electrophilic as compared to aldehydes.
 (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
 (d) Assertion (A) is incorrect, but Reason (R) is correct statement.

CBSE-2020

Ans. (d)

18. Benzaldehyde undergoes 'A' reaction due to 'B'..... of α -hydrogen atom.
In the above sentence, 'A' and 'B' respectively are:
 (a) Cannizzaro, absence
 (b) Rosenmund's, presence
 (c) Cannizzaro, presence
 (d) Rosenmund's absence

ISC Board-2016

Ans. (c)

19. Benzaldehyde undergoes 'A'..... reaction on treatment with concentrated sodium hydroxide because it has 'B'.....atom.
In the above sentence, 'A' and 'B' respectively are:

- (a) Cannizzaro, α -hydrogen
 (b) Cannizzaro, no α -hydrogen
 (c) Clemmensen, α -hydrogen
 (d) Clemmensen, no α -hydrogen

ISC Board-2015

Ans. (b)

20. When acetaldehyde is treated with Grignard reagent, followed by hydrolysis the product formed is:
 (a) primary alcohol
 (b) Secondary alcohol
 (c) carboxylic acid
 (d) Tertiary alcohol

ISC Board-2015

Ans. (b)

21. Which type of hydrogen should be present in Aldehyde or Ketone compounds for Aldol condensation reaction?

- (a) α (b) γ
 (c) β (d) δ

Gujarat Board-2020

Explain : (a)

Section-B : Very Short Answer

- How will you obtain- (Give equations only)-
 (i) Propane-2-ol from acetone?
UP Board 2019
- How will you obtain- (Give equations only)-
 (i) Chloral from acetaldehyde?
UP Board 2019
- State the name and formula of electrophile used in the nitration of benzaldehyde.
UP Board 2023
- Which one is more reactive among aldehydes and ketones?
Kerala Board 2023
- Write any two nucleophilic addition reaction of aldehyde.
Kerala Board 2023
- How does formaldehyde reacts with concentrated alkali on heating? Name this reaction.
Karnataka board 2023

7. Write chemical reaction o Aldol Condensation
Uttarakhand Board 2023
8. Arrange the following compounds in the increasing order of their property as indicated.
 (i) CH_3COCH_3 , $\text{C}_6\text{H}_5\text{COCH}_3$, CH_3CHO
 (reactivity towards nucleophilic addition reaction)
 (ii) $\text{Cl}-\text{CH}_2-\text{COOH}$, $\text{F}-\text{CH}_2-\text{COOH}$, CH_3-COOH (acidic character)

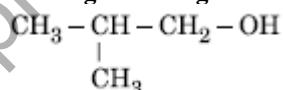
All India 2015

9. Explain the mechanism of a nucleophilic attack on the carbonyl group of an aldehyde or a ketone.
Foreign 2010

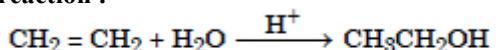
10. Give a plausible explanation for each one of the following:
 (i) There are two- NH_2 groups in semicarbazide. However, only one such group is involved in the formation of semicarbazones.
 (ii) Cyclohexanone forms cyanohydrins in good yield but 2,2,6-trimethyl cyclohexanone does not.

HOTS; Delhi 2012

11. (a) Show how you will synthesise the following alcohol prepared by the reaction of a suitable Grignard reagent on methanal ?



- (b) Write the mechanism of the following reaction :



CBSE-2019

12. Give reasons for the following :
 (a) Aquatic species are more comfortable in cold water than warm water.
 (b) At higher altitudes people suffer from anoxia resulting in inability to think.
CBSE-2019

13. What type of azeotropic mixture will be formed by a solution of acetone and chloroform ? Justify on the basis of strength of intermolecular interactions that develop in the solution.

CBSE-2019

14. Write the IUPAC name of the following compound :

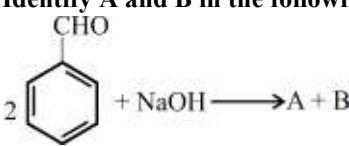
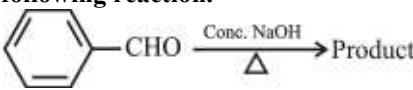
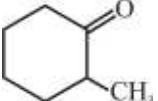


CBSE-2019

15. Give one chemical test to distinguish between the following pair of compounds:
 Formic acid and acetic acid.
ISC Board-2013

16. is more acidic than acetic acid because of effect.
ISC Board-2003

17. Give one test to distinguish between acetone and acetic acid.
ISC Board-2006
18. Write the chemical equation for the following reaction and name the main product:
Oxalic acid with glycerol at 260°C.
ISC Board-2005
19. Give one example for the following name reaction:
Hell-Volhard-Zelinsky (HVZ) reaction.
ISC Board-2010
20. Give the balanced equation for the following reaction:
Formic acid is heated with Tollen's reagent
ISC Board-2009
21. Correct the following statement:
Chloroacetic acid is more acidic than acetic acid because of the -M effect.
ISC Board-2007
22. Give the balanced equation for the following reaction:
Sucrose is warmed with concentrated nitric acid.
ISC Board-2000, 2007
23. Give the chemical test to distinguish between formaldehyde and acetaldehyde.
ISC Board-2016
24. 'Give chemical test to distinguish acetaldehyde and acetic acid.
ISC Board-2017
25. Give balanced equation for the following reactions:
 (a) Acetaldehyde is heated with hydroiodic acid in the presence of red phosphorus.
 (b) Calcium acetate is subjected to dry distillation.
 (c) Benzaldehyde is treated with sodium bisulphite
ISC Board-2014
26. An organic compound A with molecule or formula C_7H_8 on oxidation by Chromylchloride in the presence of CCl_4 gives a compound B which gives positive Tollen's test. The compound B on treatment with NaOH followed by acid hydrolysis gives two products C and D. C on oxidation gives B which on further oxidation gives D. The compound D on distillation with sodalime gives a hydrocarbon E. Below 60°C, concentrated nitric acid reacts with E in presence of concentrated sulphuric acid forming a compound F. Identify the compounds A, B, C, D, E and F.
ISC Board-2014
27. Write the balanced equations for the reaction of ammonia with formaldehyde, an acetaldehyde and acetone.
ISC Board-2001
28. What is Cannizzaro reaction? Name a compound which undergoes this reaction, Name the products formed when this compound undergoes the reaction.
ISC Board-2000
29. Write the structures of three compounds which have the same molecular formula of C_4H_8O but have different functional groups.
ISC Board-2006
30. Write balanced chemical equations for the following and name the reactions occurring in each case:
 (a) Benzaldehyde reacts with an alcoholic solution of potassium cyanide.
 (b) Propanone is treated with iodine and excess of alkali and warmed.
ISC Board-2006
31. Write chemical equation for the following reaction and name the main product:
Formaldehyde with ammonia
ISC Board-2005
32. Give one test to distinguish between the following pair. Write the relevant equation.
Acetophenone and benzophenone.
ISC Board-2014
33. How will you carry out the following conversion? Write the relevant equation
Formaldehyde to urotropine.
ISC Board-2003
34. How will you carry out the following conversion?
Acetaldehyde to iso-propyl alcohol
ISC Board-2000, 2002
35. How will you carry out the following reaction? Write the relevant balanced equations and name the reaction.
Acetyl chloride to acetaldehyde
ISC Board-2001
36. Give the balanced equations for the following:
Acetone reacts with hydrogen in the presence of heated copper.
ISC Board-2011
37. How can the following conversion be brought about ?
2-propanol to acetoxime
ISC Board-2010
38. Give one example for the following name reaction:
Clemmensen's reduction
ISC Board-2010
39. Give the balanced equation for the following reaction :
Benzaldehyde treated with hydrogen cyanide.
ISC Board-2010
40. How will you bring about the following conversion?
Acetaldehyde to acetamide
ISC Board-2009

68. An organic compound (A) with molecular formula C_3H_7NO on heating with Br_2 and KOH forms a compound (B). Compound (B) on heating with $CHCl_3$ and alcoholic KOH produces a foul smelling compound (C) and on reacting with $C_6H_5SO_2Cl$ forms a compound (D) which is soluble in alkali. Write the structures of (A), (B), (C) and (D). CBSE-2022
69. Explain the following reactions:
 (a) Wolff Kishner reduction
 (b) Cannizzaro reaction CBSE-2022
70. Draw the structure of semicarbazone of cyclopentanone. CBSE-2019
71. Draw the structure of product formed when propanal is treated with zinc amalgam and concentrated hydrochloric acid. CBSE-2019
72. What happens when
 (a) Propanone is treated with methylmagnesium iodide and then hydrolysed, and
 (b) Benzene is treated with CH_3COCl in presence of anhydrous $AlCl_3$? CBSE-2020
73. Write the name of the reagent that reacts with formaldehyde to give sodium formate and methyl alcohol. Odisha Board-2020
74. Explain Cannizzaro's reaction taking benzaldehyde as an example. Karnataka Board-2020
75. Write the equation for the reaction between benzaldehyde and concentrated NaOH Solution. Name the reaction. Karnataka Board-2019
76. Ethanal (CH_3CHO) undergoes aldol condensation reaction. Give reason. Karnataka Board-2018
77. Formaldehydes [HCHO] undergoes Cannizzaro's reaction: Give reason. Karnataka Board-2017
78. Complete the following chemical reaction.
 $\text{C=O} + \text{NH}_2\text{OH} \longrightarrow \dots + \text{H}_2\text{O}$ Karnataka Board-2016
79. Identify A and B in the following reaction.

Karnataka Board-2015
80. Aldehydes are generally more reactive than ketones towards nucleophilic addition reaction. Give any two reasons. Karnataka Board-2016
81. Explain Cannizzaro reaction with an example. Karnataka Board-2019
82. Give the structure of Butane-2, 3-dione. Haryana Board-2016
83. Give the structural formula and IUPAC name of the product formed by the reaction of propanone with CH_3MgBr in dry ether, followed by hydrolysis. Kerala Board-2019
84. Identify the products and give the name of the following reaction.

Kerala Board-2019
85. Aromatic aldehydes undergo electrophilic substitution reactions. Write the nitration reaction of benzaldehyde with chemical equation. Kerala Board-2018
86. Complete the following reactions:
 (ii) $CH_3CHO + HCN \longrightarrow ?$ Haryana Board-2017
87. Why are ketones less reactive than aldehydes? Manipur Board-2019
88. Methanal forms cyanohydrin with HCN in the presence of a base much faster than acetone, Why? Manipur Board-2022
89. A carbonyl compound on reduction by $Zn-Hg$ (zinc amalgam) and HCl gives an alkane. Give the name of the reaction. Rajasthan Board-2010
90. Write the IUPAC name of

Meghalaya Board-2019

Section-C : Short Answer

- Why are α -hydrogen atoms of aldehydes and ketones acidic in nature? Gujarat Board 2023 (July)
- Write a chemical test to distinguish between Benzaldehyde and Benzoic acid. Gujarat Board 2023 (July)
- Explain Cannizzaro reaction. MP Board 2020
- Aldehydes are more reactive than ketones towards nucleophilic addition reaction. Give one reason. Karnataka board 2023
- $2CH_3CHO \xrightarrow{\text{dil. NaOH}} x \xrightarrow[-H_2O]{\Delta} y$ Write chemical formula and IUPAC name of x and y in above chemical sequence. Rajasthan Board 2023
- Acetaldehyde reacts with Tollen's reagent. UP Board 2023
- Formaldehyde reacts with NaOH. UP Board 2023

- | | | | | | |
|-----|--|---|-----|--|---|
| 8. | Aldol condensation | UP Board 2023 | 14. | (a) Write the reactions of ethanal with
(a) LiAlH ₄
(b) dil NaOH
(c) HCN | CBSE-2022 |
| 9. | Write down the Gattermann-Koch reaction with chemical equation. | Uttarakhand Board 2023 | 15. | (b) How will you convert the following:
(i) Ethanoic acid to 2-chloroethanoic acid
(ii) Propanone to t-butyl alcohol
(iii) CH ₃ - CH = CH - CH ₂ - CN to CH ₃ - CH = CH - CH ₂ - CHO | CBSE-2022 |
| 10. | An organic compound with molecular formula C ₅ H ₁₀ O does not reduce Tollens' reagent but forms an addition compound with sodium hydrogen sulphite and gives a positive iodoform test. On vigorous oxidation, it gives ethanoic acid and propanoic acid. Identify the compound and write all chemical equations for the reactions. | All India 2012C | 16. | (i) (CH ₃) ₃ C - CHO does not undergo aldol condensation. Why ?
(ii) Distinguish between Acetophenone and Benzophenone with the help of a chemical test. | CBSE-2022 |
| 11. | (i) Describe the mechanism of the addition of Grignard's reagent to the carbonyl group of a compound to form an adduct which on hydrolysis yield an alcohol.
(ii) Draw the structure of the following compounds:
(a) 3-methylbutanal
(b) p-nitropropiophenone | Foreign 2012 | 17. | (b) (i) Which will undergo faster nucleophilic addition reaction ?
Acetaldehyde or propanone.
(ii) What is the composition of Fehling's reagent ?
(iii) Draw structure of the semicarbazone of Ethanal. | CBSE-2022 |
| 12. | (a) Predict the main product of the following reactions : | | 18. | Predict the products formed when CH ₃ CHO reacts with the following reagents : (any two)
(i) CH ₃ MgBr and then H ₃ O ⁺
(ii) Zn(Hg)/Conc. HCl
(iii) Tollen's reagent | CBSE-2022 |
| | (i) | | | (a) | Write the major products in the following: |
| | (ii) | | | (i) | |
| | (iii) | | | | $\xrightarrow[273-283K]{HNO_3 + H_2SO_4}$ |
| | (b) | Give a simple chemical test to distinguish between. | | (ii) | |
| | | | | | $+ NaOH \xrightarrow[\Delta]{Cu(OH)_2}$ |
| | (c) | Why is alpha (α) hydrogen of carbonyl compounds acidic in nature ? | | (iii) | $\text{CH}_3-\underset{\text{H}}{\text{C}}=\text{O} \xrightarrow{\text{NH}_2\text{OH}}$ |
| | | CBSE-2019 | | | CBSE-2022 |
| 13. | (a) Write the main product formed when propanal reacts with the following reagents :
(i) 2 moles of CH ₃ OH in presence of dry HCl
(ii) Dilute NaOH
(iii) H ₂ N - NH ₂ followed by heating with KOH in ethylene glycol
(b) Arrange the following compounds in increasing order of their property as indicated :
(i) F - CH ₂ COOH, O ₂ N - CH ₂ COOH, CH ₃ COOH, HCOOH — acid character
(ii) Acetone, Acetaldehyde, Benzaldehyde, Acetophenone — reactivity towards addition of HCN | | 20. | (b) (i) Oxidation of propanal is easier than propanone. Why ?
(ii) How can you distinguish between Acetophenone and Benzophenone ?
(iii) Draw the structure of the following derivative :
2,4-Dinitrophenylhydrazone of Propanone | CBSE-2022 |
| | | | | | CBSE-2022 |
| | | | 21. | (a) Write the equations involved in the following reactions :
(i) Cannizzaro reaction
(ii) Aldol condensation
(iii) Hell-Volhard-Zelinsky reaction | CBSE-2022 |
| | | | | | CBSE-2022 |

- (b) Complete the following reaction:
- $\text{HCHO} + \text{conc. KOH} \xrightarrow{\Delta}$
 - $\text{CH}_3\text{CHO} \xrightarrow{\text{dil NaOH}}$
 - $\text{CH}_3\text{CHO} + \text{H}_2\text{N-NH}_2 \rightarrow$
 - $\text{C}_6\text{H}_5\text{COCH}_3 \xrightarrow[\text{HCl}]{\text{Zn/Hg}}$
- Kerala Board-2016
41. Give balanced equations for the following reactions:
 (iii) Acetaldehyde with hydroxylamine.
 ISC Board-2017
42. Complete the following reactions:
 (iii) $\text{HCHO} + \text{NaOH} \longrightarrow ?$
 Haryana Board-2017
43. Write the chemical reaction of carbonyl group with:
 (i) H_2O
 (ii) HCN
 (iii) $\text{Na}^+\text{HSO}_3^-$
 Haryana Board-2017
44. Why aldehyde undergo nucleophilic addition reactions more readily than ketones? Explain.
 Haryana Board-2017
45. Describe the following:
 (i) Wolff-Kishner reduction
 (ii) Cross Aldol condensation
 (iii) Stephen reaction
 Haryana Board-2018
46. Write the major products in the following reaction:
 (i)
 (ii)
 Haryana Board-2018
47. Describe the following:
 (a) Aldol condensation
 (b) Cannizzaro reaction
 Haryana Board-2018
48. Describe the following:
 (i) Stephen reaction
 (ii) Rosenmund reduction
 Haryana Board-2018
49. Write the equation of chemical reaction and main of reaction obtained following compounds (A) and (B) from CH_3CHO .
 (a) But-2-enal (b) Chloroform
 Rajasthan Board-2017
50. Write chemical equation of Cannizaro reaction.
 Rajasthan Board-2017
51. Give one difference between Clemmensen reduction & Wolff Kishner reduction?
 Rajasthan Board-2016
52. Explain aldol reaction with chemical equation?
 Rajasthan Board-2016
53. Write a note on Rosenmund reduction.
 Rajasthan Board-2015
54. Write Knoevenagel reaction.
 Tamilnadu Board, Sep.-2016
55. Give the following reactions:
 (i) Benzoin, condensation
 (ii) Knoevenagel reaction
 Tamilnadu Board, March-2016
56. (a) How will you convert the following? Give equations only.
 (i) Benzene to acetophenone
 (ii) Benzoic acid to Benzaldehyde
 Assam Board-2020
57. Explain aldol condensation reactions of ethanol and propanone.
 Gujarat Board-2017
58. Identify the product of the following reactions: (any two)

$$\text{CH}_3 - \underset{\substack{| \\ \text{CH}_3}}{\text{C}} = \text{O} \xrightarrow[\substack{\text{(ii) KOH/Glycol, } \Delta \\ \text{Assam Board-2019}}]{\substack{\text{(i) H}_2\text{N-NH}_2 \\ |}} ?$$
59. $\text{C}_2\text{H}_5 - \text{CO} - \text{CH}_3 \xrightarrow{\text{NaOH/I}_2} ?$
 Assam Board-2019
60.
 Assam Board-2019
61. What happens when—
 (i) Cyclohexanecarbaldehyde reacts with PhMgBr and then H_3O^+ .
 Assam Board-2019
62. Carbonyl compound is treated with zinc-amalgam and concentrated hydrochloric acid.
 Assam Board-2019
63. Give an example of Clemmensen reduction reaction.
 Assam Board-2017
64. Identify the products A and B in the following reaction:

$$2\text{HCHO} + \text{conc. KOH} \xrightarrow{\Delta} \text{A} + \text{B}$$

 Assam Board-2017
65. Write complete chemical equation for the transformation of benzamide to benzoic acid.
 Assam Board-2017
66. (a) How will you bring about the following conversions? (Give chemical equations only):
 (i) Toluene to benzaldehyde.
 (ii) Ethanenitrile to ethanoic acid.
 Assam Board-2015
67. What happens, when—
 (a) Ethanal is treated with methyl magnesium bromide and the product is hydrolysed;
 (b) Phenol is heated with zinc dust;
 (c) Methoxyethane is treated with excess HI.
 Assam Board-2013

67. (a) Given one example of each of the following reaction:

(i) Clemmensen reduction.
(ii) Cannizzaro reaction.

(b) A Compound X (C_2H_4O) on oxidation gives Y ($C_2H_4O_2$) 'X' undergoes haloform reaction On treatment with HCN, 'X' forms a product 'Z' which on hydrolysis gives 2-Hydroxypropanoic acid.

(i) Indentify X, Y and Z and give their name and structure.
(ii) Write the equations of the reactions involved.

Assam Board-2012

68. Which compound is produced when ethanal is heated with dilute NaOH solution?

Assam Board-2012

69. Write short notes on the following:

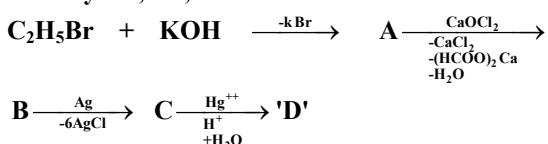
(i) Perkin reaction (ii) Urotropine

MP Board-2017

70. An alcohol 'A', on reaction with conc H_2SO_4 gives an alkane 'B'. 'B' after Bromination with sodamide give dehydrogenated compound 'C'. 'C' on reaction of H_2SO_4 in presence of $HgSO_4$ gives 'D'. Identify 'A', 'B', 'C' & 'D'.

MP Board-2017

71. Identify 'A', 'B', 'C' & 'D'.



MP Board-2017

72. What happens when: (Write equations)

(i) Acetone is heated with Alkaline solution of Iodine.
(ii) Chlorobenzene is heated with chloral in presence of conc- H_2SO_4 .
(iii) Chlorobenzene is heated with Sodium in presence of ether.
(iv) Ethyl bromide is heated with Alcoholic-KOH.

MP Board-2016

73. Write notes on-

(i) Cannizzaro reaction.
(ii) Perkin reaction.

MP Board-2015

74. How will you bring out the following conversion-

(i) Acetyl chloride to Acetaldehyde
(ii) Methanal to Ethanal

MP Board-2015

75. Write short notes on the following :

(i) Claisen condensation
(ii) Benzoin condensation.

MP Board-2014

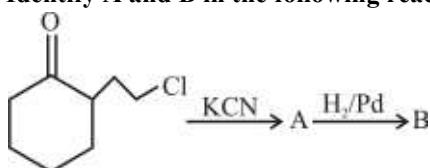
76. Give any two oxidizing reactions of $KMnO_4$ in acidic medium.

J & K Board-2021

77. Explain Reimer-Tiemann reaction. Write the reaction involved in it.

Nagaland Board-2020

78. Identify A and B in the following reaction :



Meghalaya Board-2019

79. Which of the following compound would undergo Cannizzaro reaction?

(a) Formaldehyde
(b) Acetaldehyde

Assam Board-2023

80. Write short notes on the following

(a) Aldol condensation
(b) Williamson's synthesis
(c) Williamson's synthesis
(d) Carbylamine reaction

Jharkhand Board-2023

Section-D : Case Based Study

1. An organic compound with molecular formula $C_5H_{10}O$ exists in different isomeric structures. Identify the isomer which-

(i) undergoes Cannizzaro reaction.
(ii) undergoes haloform reaction and gives butanoic acid.
(iii) is obtained by ozonolysis of 3,4-diethylhex-3-ene.

Manipur Board 2023

2. Read the passage given below and answer the questions that follow:

Aldehydes differ from ketones in their oxidation reactions. Aldehydes are easily oxidised to carboxylic acids on treatment with common oxidising agents like nitric acid, $KMnO_4$, $K_2Cr_2O_7$, etc. Even mild oxidising agents mainly Tollen's reagent and Fehling solution also oxidize aldehydes, ketones are generally oxidised under vigorous conditions.

Aldehydes and ketones undergo nucleophilic addition reactions onto the carbonyl group with a number of nucleophiles such as HCN, $NaHSO_3$, alcohols, ammonia derivatives and Grignard reagents. The α -hydrogens of aldehydes and ketones are acidic due to which they undergo Aldol condensation.

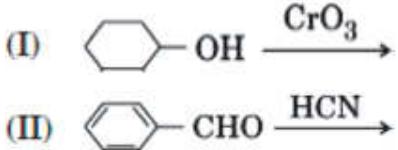
(i) Why is the oxidation of Aldehydes easier than Ketones ?

(ii) Arrange the following compounds in the increasing order of their reactivity towards nucleophilic addition reaction :

Ethanal, Acetone, Propanal, Acetophenone

(iii) Write a simple chemical test to distinguish between Acetone and Ethanal.

(iv) (a) Write the major product in the following reactions.



CBSE-2022

3. Read the following passage and answer the questions that follow :

A class of organic molecules which contain a carbon atom connected to an oxygen atom by a double bond is called Aldehydes and Ketones. It is called as carbonyl group. Aldehydes are prepared by the oxidation of alcohols. Formaldehyde is sold in an aqueous solution called formalin. Propanone, a simplest ketone is commercially prepared by fermenting corn or by oxidation of propan-2-ol. Carboxylic acids also have carbonyl carbon. They can be prepared by the oxidation of alcohols and aldehydes.

Formic acid was first isolated by the distillation of red ants. It is partially responsible for the pain and irritation of ant and wasp stings. Aldehydes undergo many nucleophilic addition reactions. They can be reduced to primary alcohols. The aldehydes with α -hydrogen undergo aldol condensation and the aldehydes without α -hydrogen undergo Cannizzaro reaction.

Ketones are highly reactive, although less so than aldehydes. Ketones are obtained by oxidation of secondary alcohols. Ketones possessing α -hydrogens also undergo aldol condensation. Carboxylic acids occur widely in nature and are used in the production of plastics, esters, etc. Aspirin is prepared from acetic acid. Similar to aldehydes and ketones, carboxylic acids can be halogenated at the α -carbon by reacting with a halogen in presence of phosphorus.

- (a) Which of the following compounds would undergo aldol condensation ?
Methanal, Benzaldehyde, Ethanal
- (b) Write the chemical test to distinguish between propanal and propanone.
- (c) Write the reagent required in the following reaction :
- $$\text{CH}_2 = \text{CH} - \text{CH}_2\text{OH} \xrightarrow{?} \text{CH}_2 = \text{CH} - \text{CHO}$$
- (d) (i) An alcohol 'A', ($\text{C}_3\text{H}_8\text{O}$) on oxidation gives compound 'B' 'B' gives negative Tollens' test and reacts with hydrazine to give compound 'C'. 'B' reacts with NaOH and I_2 to give yellow precipitate of 'D'. Identify 'A', 'B', 'C' and 'D'.

CBSE-2022

4. (a) Write the chemical reactions for the following:
- (I) Clemmensen reduction
(II) HVZ reaction

CBSE-2022

5. (a) An organic compound with the molecular formula $\text{C}_7\text{H}_6\text{O}$ forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro reaction. On oxidation, it gives benzoic acid. Identify the compound and state the reactions involved.

- (b) Give chemical tests to distinguish between the following pair of compounds :

- (i) Phenol and propanol
(ii) Benzoic acid and benzene

CBSE-2019

An Organic compound A of molecular formula $\text{C}_3\text{H}_6\text{O}$ answers iodoform test Another organic compound B of molecular formula $\text{C}_7\text{H}_6\text{O}$ is known as oil of bitter almonds. A reacts with B to form an unsaturated compound C of molecular formula $\text{C}_{10}\text{H}_{10}\text{O}$ compound B react with malonic acid in the presence of pyridine to form an unsaturated acid D of molecular formula $\text{C}_9\text{H}_8\text{O}_2$. Identify A, B, C and D. Explain the reactions.

Tamil Nadu Board-2016

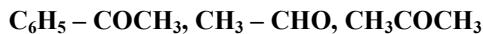
Section-E : Long Answer

1. What happens when (write chemical equation only)-

- (i) Benzaldehyde is heated with NaOH ?
(ii) Formaldehyde is reacted with NH_3 ?
(iii) Acetone is reacted with HCN ?
(iv) Toluene is oxidized with CrO_2Cl_2 ?
(v) Acetaldehyde is reacted with dilute base?

UP Board 2019

2. (i) Write the chemical reaction involved in Wolff-Kishner reduction.
(ii) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction.



- (iii) Why carboxylic acid does not give reactions of carbonyl group?
(iv) Write the product in the following reaction:



- (v) A and B are two functional isomers of compound $\text{C}_3\text{H}_6\text{O}$. On heating with NaOH and I_2 , isomer B forms yellow precipitate of iodoform whereas isomer A does not form any precipitate. Write the formula of A and B.

All India 2016

3. (i) Write the chemical equations for the reaction involved in cannizzaro reaction.
(ii) Draw the structure of semicarbazone of ethanol.
(iii) Why pK_a of $\text{F} - \text{CH}_2 - \text{COOH}$ is lower than that $\text{Cl} - \text{CH}_2 - \text{COOH}$?
(iv) Write the product in the following reaction



- (v) How can you distinguish between propanal and propanone?

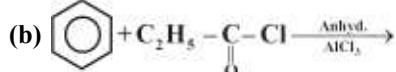
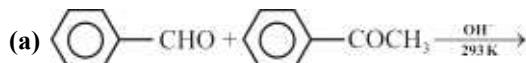
Delhi 2016

4. An organic compound A (C_3H_6O) is resistant to oxidation but forms compound B(C_3H_8O) on reduction. B reacts with HBr to form the compound C.

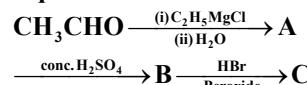
C with Mg forms Grignard's reagent D which reacts with A to form a product which on hydrolysis gives E. Identify A to E.

All India 2008C

5. (i) An organic compound A (C_3H_8O) on treatment with copper at 573 K gives B. B does not reduce Fehling's solution but gives a yellow ppt. of compound C with $I_2/NaOH$. Deduce the structures of A, B, and C.
(ii) Predict the products of the following reactions:



6. (i) Identify A, B and C in the following sequence of reactions:



(ii) Predict the structures of products formed when benzaldehyde is treated with

- (a) conc. NaOH
(b) HNO_3/H_2SO_4 (at 273 – 383 K)

Delhi 2011C

7. A ketone A (C_4H_8O) which undergoes a haloforms reaction and gives compound B on reduction. B on heating with sulphuric monoozonide D. D on hydrolysis with zinc dust gives only E. Identify A, B, C, D and E. Write the reactions involved.

Delhi 2010C

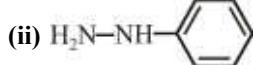
8. (i) Draw the structures of the following derivatives:

- (a) Propanone oxime
(b) Semicarbazone of CH_3CHO
(ii) How will you convert ethanal into the following compounds? Give the chemical equations involved:
(a) $CH_3 - CH_3$
(b) $CH_3 - CH(OH) - CH_2 - CHO$
(c) $CH_3CH_2 OH$

All India 2015C

9. (a) Write the products formed when benzaldehyde reacts with the following reagents :

- (i) CH_3CHO in presence of dilute NaOH



- (iii) Conc. NaOH

- (b) Distinguish between following :

- (i) $CH_3 - CH = CH - CO - CH_3$ and $CH_3 - CH_2 - CO - CH = CH_2$

- (ii) Benzaldehyde and Benzoic acid

CBSE-2020

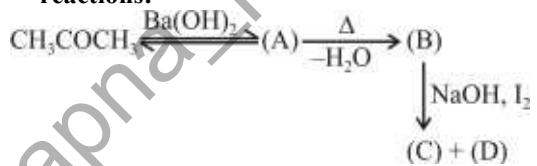
10. (a) An organic compound (A) having molecular formula C_4H_8O gives orange red precipitate with 2, 4-DNP reagent. It does not reduce Tollens' reagent but gives yellow precipitate of iodoform on heating with $NaOH$ and I_2 . Compound (A) on reduction with $NaBH_4$ gives compound (B) which undergoes dehydration reaction on heating with conc. H_2SO_4 to form compound (C). Compound (C) on Ozonolysis gives two molecules of ethanal. Identify (A), (B) and (C) and write their structures. Write the reactions of compound (A) with (i) $NaOH/I_2$ and (ii) $NaBH_4$.

- (b) Give reasons :

- (i) Oxidation of propanal is easier than propanone.
(ii) α -hydrogen of aldehydes and ketones is acidic in nature.

CBSE-2020

11. (a) Complete the following sequence of reactions:



- (i) Identify (A) to (D).

- (ii) Give the IUPAC name of (A).

- (b) How can you distinguish between:

- (i) Ethanol and Propanone, and
(ii) Benzoic acid and phenol?

CBSE-2020

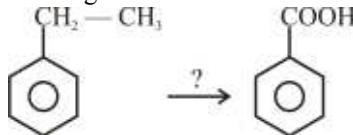
12. Write chemical reactions to affect the following transformations.

- (i) Butanal to butanoic acid
(ii) Acetone of propane
(iii) Benzaldehyde to m-nitro benzaldehyde

Gujarat Board-2021

13. Do as directed:

- (a) Write the reagent used to bring about the following conversion:

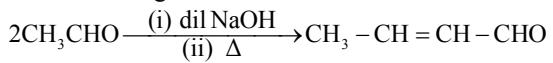


- (b) Write labelled chemical equation to show, what happens when Benzene is treated with acetylchloride in the presence of anhydrous $AlCl_3$

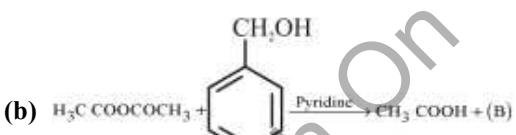
- (c) Arrange the following compounds in the increasing order of their reactivity towards nucleophilic addition reaction:

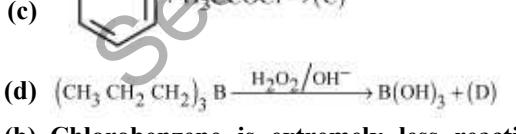
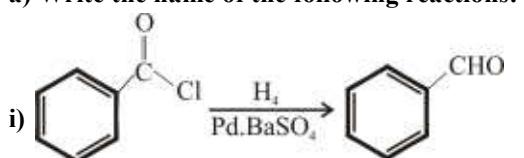
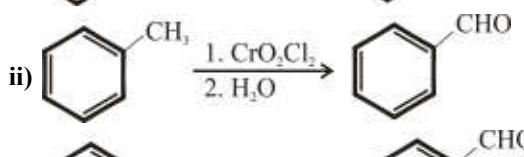
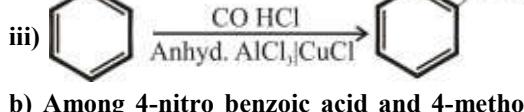


- (d) State the name of the reaction in the following conversion:



Goa Board-2023

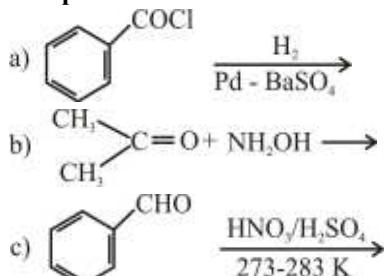
14. (a) Write down the following reactions with chemical equation :
 (i) Rosenmund's reaction
 (ii) Aldol condensation
 (b) Write down any two uses of acetic acid :
 Chhattisgarh Board-2023
15. (c) Write down the following reactions with chemical equation :
 (i) Stephen's reaction
 (ii) Iodoform reaction
 (d) Write down any two uses of formic acid.
 Chhattisgarh Board-2023
16. Explain the mechanism of Cannizzaro reaction.
 Tamil Nadu Board-2011
17. a) (i) What products will be obtained when 2-chlorobutane is reacted with alcoholic solution of KOH? Which will be the major product and why? Write chemical equation involved.
 (ii) Which of these two alkenes will yield propanal and methanal on ozonolysis? Give chemical equation in support of your answer.
 b) Account for the following:
 (i) p-dichlorobenzene has higher melting point than that of ortho or meta isomer.
 (ii) Alcohols have higher boiling points than that of alkanes and haloalkanes of comparable molecular mass.
 NIOS Board-2021
18. (a) Identify A, B, C and D and write their names.
 (a) $\text{CH}_3(\text{CH}_2)_3\text{CHO} \xrightarrow[\text{HCl, H}_2\text{O}]{\text{Zn/Hg}} (\text{A})$

 (b) $\text{H}_3\text{C COOCOCH}_3 + \text{C}_6\text{H}_5\text{CH}_2\text{OH} \xrightarrow{\text{Pyridine}} \text{CH}_3\text{COOH} + (\text{B})$

 (c) $\text{C}_6\text{H}_5\text{NH}_2 + \text{CH}_3\text{COCl} \rightarrow (\text{C})$

 (d) $(\text{CH}_3\text{CH}_2\text{CH}_2)_3\text{B} \xrightarrow{\text{H}_2\text{O}_2/\text{OH}^-} \text{B}(\text{OH})_3 + (\text{D})$
 (b) Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction. Give two reasons for the same.
 NIOS Board-2019
19. a) Explain Rosenmund reduction with equation.
 b) How does propanone (CH_3COCH_3) reacts with hydrazine? Give equation.
 c) Name an oxidising agent used in the Etard's reaction.
- Karnataka Board-2018
20. a) How benzene is converted into benzoaldehyde by Gattermann-Koch reaction? Write equation
 b) Complete and name the following reaction.
 c) What is the effect of electron withdrawing group on the acidity of carboxylic acid.
 Karnataka Board-2017
21. Explain the reaction mechanism of acetaldehyde involved simple aldol condensation.
 Tamil Nadu Board-2016
22. How will you carry out the following conversions. Give reactions.
 (i) Decanol to Decanal
 (ii) Aniline to Fluorobenzene
 NIOS Board-2023
23. Write labelled chemical equation to show what happens when:
 (a) Toluene reacts with chlorine in the presence of light followed by hydrolysis at 373 K
 (b) Acetophenone reacts with zinc amalgam and hydrochloric acid.
 (c) Formaldehyde reacts with phenylmagnesium bromide followed by hydrolysis.
 (d) Vapours of Butan-2-ol are passed over heated copper at 573 K.
 Goa Board-2018
24. Write short notes on the following :
 (a) Carbylamine reaction
 (b) Hormann's bromamide reaction
 (c) Gattermann reaction.
 Jharkhand Board-2018
25. Starting from Acetaldehyde how will you get
 (i) 1,1-Dichloroethane
 (ii) Acetal
 (iii) Acetal diamine
 (iv) Ethane
 (v) Acetal oxime
 J&K Board-2019
26. a) Write the name of the following reactions:
- i) $\text{C}_6\text{H}_5\text{CH}_2\text{Cl} \xrightarrow[\text{Pd.BaSO}_4]{\text{H}_2} \text{C}_6\text{H}_5\text{CHO}$

 ii) $\text{C}_6\text{H}_5\text{CH}_3 \xrightarrow[2. \text{H}_2\text{O}]{1. \text{CrO}_2\text{Cl}_2} \text{C}_6\text{H}_5\text{CHO}$

 iii) $\text{C}_6\text{H}_6 \xrightarrow[\text{Anhyd. AlCl}_3|\text{CuCl}]{\text{CO HCl}} \text{C}_6\text{H}_5\text{CHO}$

- b) Among 4-nitro benzoic acid and 4-methoxy benzoic acid, which is more acidic? Give one reason.
 Karnataka Board-2020

27. a) i) How does benzaldehyde reacts with acetophenone in presence of a dilute alkali?
ii) Name the product formed when acetaldehyde reacts with HC.
b) Among formic acid and acetic acid, which is more acidic? Give reason.

Karnataka Board-2016

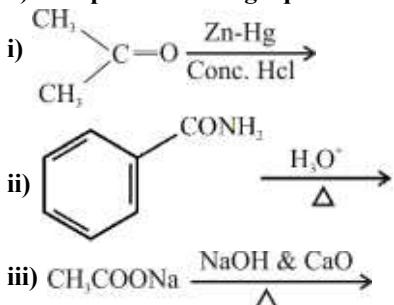
28. Complete the reaction.



- b) Explain Cannizzaro's reaction with an example.

Karnataka Board-2017

29. a) Complete following equations



Karnataka Board-2018

30. (i) How will you prepare Benzaldehyde from the followings:
(a) Toluene
(b) Benzene
(c) Benzoyl chloride
(ii) Identify the product obtained when Acetic acid is heated with P_2O_5 .

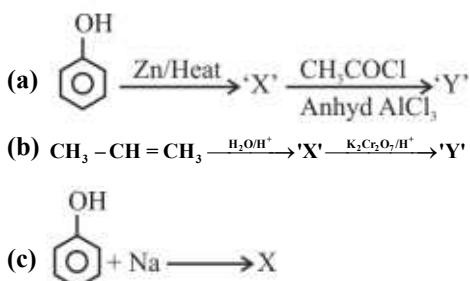
Kerala Board-2021

31. Write short notes on the following :

- (a) Aldol condensation
(b) Sandmeyer reaction
(c) Stephen reaction

OR

Identify 'X', 'Y' and 'Z' in the following :

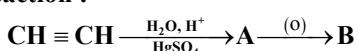


Jharkhand Board-2019

32. Answer the following questions.

- (i) Arrange the following compounds in order of their increasing reactivity towards HCN :
 CH_3CHO , $HCHO$, CH_3COCH_3 .

- (ii) Write structures A and B in the following reaction :



- (iii) Write a chemical equation for the preparation of Benzamide from Benzoic acid.

- (iv) Write structures of the following:

- (a) Phenyl hydrazine derivative of benzaldehyde

- (b) Cyclohexanone oxime.

Goa Board-2019

33. Write chemical equations for the following conversions :

- (i) Phenol to Benzene

- (ii) Acetaldehyde to Butan 2 - ol

- (iii) Anisole to 4-Nitroanisole.

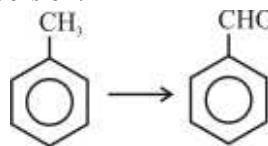
Goa Board-2019

34. (i) Write the products of the following reaction:



- (ii) Explain Hell-Volhard-Zelinsky (HVZ) reaction.

- (iii) Suggest a suitable method for the following conversion:



Kerala Board-2022

35. Explain the following reactions:

- (a) Rosenmund reduction

- (b) Cannizzaro reaction

Kerala Board-2020

36. Explain the following (write only chemical equation):

- (a) Gattermann-Koch reaction

- (b) Stephen's reaction

- (c) Rosenmund reaction

- (d) Aldol condensation

- (e) Cannizzaro reaction

Chhattisgarh Board-2020

37. What happens when (write only chemical equation)?-

- (a) Grignard reagent is treated with CO_2

- (b) Carboxylic acid reacts with alcohol

- (c) Acetaldehyde reacts with HCN

- (d) Aldehyde reacts with $NaHSO_3$

- (e) Acetic acid reacts with Na metal

Chhattisgarh Board-2020

38. What is Cannizaro's reaction? Write its mechanism?

Haryana Board-2017

39. Describe the following:
 (a) Wolff-Kishner reduction.
 (b) Clemmensen reduction.
 (c) Cross Aldol condensation.
- Haryana Board-2016
40. Convert benzene into:
 (a) Benzaldehyde
 (b) Benzoic acid
 (c) Acetophenone
- Haryana Board-2016
41. (a) An organic compound 'A' (molecular formula C_3H_6O) which does not give Tollen Test, on reduction gives compound 'B' (C_3H_8O). Compound 'B' on treatment with HBr gives Bromide 'C' which on treatment with alcoholic KOH gives Alkene 'D' (C_3H_6). Identify compounds A, B, C, D.
 (b) Name the following compound according to IUPAC System of Nomenclature.
 (i) $CH_3CH(CH_3)CH_2CH_2CHO$
 (ii) $CH_3CH(CH_3)CH_2C(CH_3)_2COCH_3$
- Uttarakhand Board-2019
42. Aldehydes, Ketones and Carboxylic acids are Carbonyl compounds.
 (a) Aldehydes differ from Ketones in their oxidation reactions. Illustrate with one example.
 (b) How will you prepare benzaldehyde by Gatterman-Koch reaction?
 (c) Write the reaction of carboxylic acid with the following reagents. (Write the chemical equations).
 (i) Thionyl chloride ($SOCl_2$)
 (ii) Chlorine in presence of small amount of red phosphorous.
 (iii) Lithium Aluminum hydride ($LiAlH_4$)/ether.
- Kerala Board-2016
43. CH_3COCH_3 on reacting with the following will give what product? Explain.
 (i) NH_2OH
 (ii) HCN
 (iii) $\begin{array}{c} CH_2OH \\ | \\ CH_2OH \end{array}$
- Haryana Board-2018
44. Explain the following with suitable example :
 (a) Rosenmund reduction
 (b) Gatterman-Koch reaction .
- Rajasthan Board-2014
45. Explain the following with suitable example :
 (a) Clemmensen reduction
 (b) Stephen reaction.
- Rajasthan Board-2014
- 46.(c) An organic compound with molecular formula C_3H_6O (A) does not reduce Tollen's reagent but undergoes Iodoform reaction. Compound (A) reacts with $Zn/Hg-HCl$ gives the Compound (B), which is a hydrocarbon. In the presence of Conc. H_2SO_4 compound (A) condenses to give compound (C) of molecular formula C_9H_{12} Identify (A),(B),(C) and explain the reactions.
- Tamilnadu Board, March-2016
47. Describe cross aldol condensation reaction between acetone and acetaldehyde.
- Gujarat Board-2018
48. Give conversion in three step : Benzonitrile from chlorobenzene.
- Gujarat Board-2018
49. Explain the chemical reactions of the following:
 (a) Rosenmund Reduction
 (b) Cannizzaro Reaction
 (c) Gattermann aldehyde synthesis
 (d) Perkin's Reaction.
- MP Board-2012
50. Explain the following:
 (a) Aldol condensation
 (b) Cannizzaro's reaction
- J & K board-2023
51. (c) Give the structure of the products you would expect when Butan-1-ol reacts with the following:
 (i) $SOCl_2$
 (ii) $HCl-ZnCl_2$
- OR
- (d) Identify the products A, B, C and D from the following reactions:
- (i) $\xrightarrow[\text{623K, 300 atm}]{NaOH, HCl} A \xrightarrow[\Delta]{Zn-dust} B$
- (ii) $CH_3CHO \xrightarrow[\text{(ii) } H_2O/H^+]{\text{(i) } CH_3MgBr} C \xrightarrow[\text{443K}]{H_2SO_4} D + H_2O$
- Meghalaya Board-2021
52. Convert cumene to phenol.
 Give the structure and IUPAC names of the products expected from the following reactions:
 (i) Catalytic reduction of butanol
 (ii) Hydration of propene in the presence of dilute sulphuric acid.
- Meghalaya Board-2021
53. (a) (i) What is Cannizzaro reaction? Give the reaction.
 (ii) (a) $CH_3-C(=O)-Cl + CH_3-Cl \rightarrow$
 (b) $+ CrO_2Cl_2 \rightarrow$
- OR

- (b) (i) Explain Clemmensen reduction with reaction.
(ii) Would benzaldehyde be more reactive or less reactive in nucleophilic addition reactions than propanol? Explain.

Nagaland Board-2021

54. (i) What is aldol-condensation reaction? Write the reaction involved in it.
(ii) What happens when
a. Aldehyde reacts with hydroxylamine
b. Ketone reacts with hydrazine.

Nagaland Board-2018

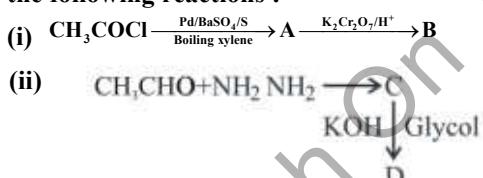
55. (i) Why are aldehydes more reactive than ketones towards nucleophilic addition reaction?
(ii) Give the reaction involved in –
(A) Cannizzaro reaction
(B) Clemmensen reduction.

Nagaland Board-2017

56. (i) What is Fehling's solution test?
(ii) Give the reaction of Grignard reagent with aldehyde and ketone.

Nagaland Board-2017

57. (a) Name one reagent used to distinguish acetaldehyde from acetone.
(b) Bring out the following conversions :
(i) But-2-ene to ethanol
(ii) Acetic acid to ethanol
(c) Why carboxylic acids do not give the characteristic reactions of carbonyl group?
(d) What type of aldehydes and ketones undergo aldol condensation?
(e) Why does benzoic acid not undergo Friedel-Crafts reaction?
(f) Convert toluene to 3-nitrobenzoic acid.
(g) Identify the products A, B, C and D from the following reactions :



Meghalaya Board-2018

D. Chemical and Physical Properties of Aldehydes and Ketones

Section-A : Multiple Choice Questions

1. Salicylaldehyde on heating with zinc dust given organic product.
(a) Benzene (b) benzaldehyde
(c) benzoic acid (d) Benzyl alcohol

Gujarat Board 2023 (March)

- Ans. (b)
2. Which catalyst is used to get methanal from H_2 and CO ?
(a) Ni (b) $\text{Cu}/\text{ZnO} - \text{Cr}_2\text{O}_3$
(c) Cu (d) Pt

Gujarat Board 2022 (July)

Ans. (b)

3. Which of the following reduces Fehling solution?
(a) Acetic Acid (b) Benzoic Acid
(c) Oxalic Acid (d) Formic Acid

Uttarakhand Board 2023

Ans. (d)

4. Which of the following compounds does not give Iodoform test?
(a) Acetophenone (b) Methyl alcohol
(c) Acetone (d) Isopropyl alcohol

Gujarat Board-2021

Ans. (d)

5. Methyl Ketones are usually characterized by:
(a) The Fehling's solution
(b) The iodoform test
(c) The Schiff's test
(d) The tollen's reagent

Tamil Nadu Board-2015

Ans. (b)

6. Iodoform test is not given by:
(a) 2-Pentanone (b) 3-Pentanone
(c) Ethanol (d) Ethanal

Haryana Board-2017

Ans. (b)

7. The acid which reduces Tollen's reagent:
(a) acetic acid (b) benzoic acid
(c) formic acid (d) oxalic acid

Tamilnadu Board, Sep.-2016

Ans. (c)

8. Which of the following compound will not give silver mirror test?
(a) Benzaldehyde (b) Methanol
(c) Acetone (d) Acetaldehyde

Gujarat Board-2017

Ans. (c)

9. When acetic acid reacts with calcium hydroxide and the product is distilled dry, the compound formed is
(a) calcium acetate (b) acetone
(c) acetaldehyde (d) acetic anhydride

ISC Board-2012

Ans. (b)

10. Which compound giving Fehling test
(a) Acetophenone (b) Acetone
(c) Benzaldehyde (d) Glucose

Gujarat Board-2018

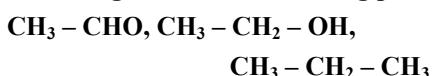
Ans. (d)

Section-B : Very Short Answer

1. Describe any two tests to distinguish aldehydes from ketones.
2. Arrange the following compounds in an increasing order of their reactivity in nucleophilic addition reactions:
Ethanal, propanal, propanone, butanone.

Delhi 2012

3. Rearrange the following compounds in the increasing order of their boiling points.

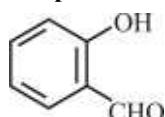


All India 2013

4. (a) Arrange the following compounds in the increasing order of their boiling points :



- (b) Write the IUPAC name of the given compound :

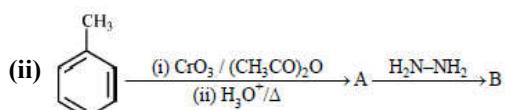


CBSE-2022

5. Oxidation of $\text{CH}_3 - \text{CHO}$ is easier than $\text{CH}_3 - \text{COCH}_3$. Why ?

CBSE-2019

6. Write structures of main compounds A and B in each of the following reactions :



CBSE-2019

7. α -hydrogen atoms of aldehydes and ketones are acidic in nature. Why ?

CBSE-2019

8. What happens when

(a) Butanone is treated with methylmagnesium bromide and then hydrolysed, and

(b) Sodium benzoate is heated with soda lime?

CBSE-2020

9. Mention the hybridised state of carbonyl carbon atom.

Karnataka Board-2014

10. Give a chemical test to distinguish between propanone and propanal.

Haryana Board-2016

11. What do you understand by the following terms? Give one example of reaction of each :

(i) Acetal

(ii) Aldol

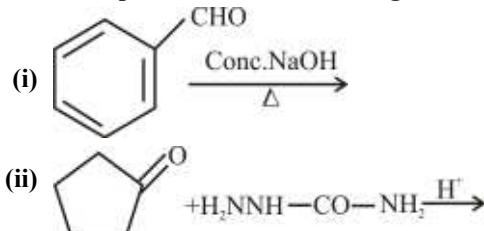
Chhattisgarh Board-2021

Section-C : Short Answer

1. For identification of which ion brown ring test is carried out? Write down chemical equations involved in this test.

Gujarat Board 2023 (March)

2. Write the products of the following reaction:



Gujarat Board 2023 (July)

3. Explain Tollen's test used for distinguishing propanal and propanone.

Rajasthan Board 2022

4. (a) Why are metal hydroxides better alternatives than sodium hydrogen carbonate in antacids ?

(b) Why is aspirin used in the prevention of heart-attacks ?

(c) Why antihistamines do not affect the secretion of acid in stomach ?

CBSE-2019

5. (a) Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions:

Ethanal, Propanal, Propanone, Butanone.

(b) Why does Benzaldehyde not undergo aldol condensation ?

(c) Write a simple chemical test to distinguish between Pentan-2-one and Pentan-3-one.

CBSE-2022

6. (b) An organic compound (A) with molecular formula $\text{C}_5\text{H}_{10}\text{O}$ does not reduce Tollen's reagent but forms an addition compound with NaHSO_3 and gives positive iodoform test on heating with NaOH in the presence of I_2 . On vigorous oxidation, it gives ethanoic and propanoic acid.

Write

(i) the possible structure of the compound.

(ii) the IUPAC name of the compound.

(iii) the reaction of (A) with NaHSO_3 .

CBSE-2022

7. A compound 'A' ($\text{C}_2\text{H}_4\text{O}$) on oxidation gives 'B' ($\text{C}_2\text{H}_4\text{O}_2$). 'A' undergoes Iodoform reaction to give yellow precipitate and reacts with HCN to form the compound 'C'. 'C' on hydrolysis gives 2-hydroxyporpanoic acid. Identify the compounds 'A', 'B' and 'C'. Write down equations for the reactions involved.

CBSE-2022

30. Name the functional group of a compound that gives silver mirror test with Tollen's reagent.
Assam Board-2017
31. Give a chemical test with equation to distinguish between methanal and ethanal.
Assam Board-2016
32. An organic compound has the molecular formula $C_5H_{10}O$. The compound does not reduce Tollen's reagent, but reacts with Brady's reagent to give orange precipitate. On vigorous oxidation, the molecule produces ethanoic acid and propanoic acid. The compound also gives iodofrom test. Identify the compound and write equations for chemical reactions involved.
Assam Board-2016
33. What happens when carbonyl compound is treated with zinc-amalgam and concentrated hydrochloric acid? Give Chemical equation. What is the name of the reaction?
Assam Board-2016

Section-D : Case Based Study

1. Write the self aldol and cross aldol products of ethanal and propan-2-one.

Gujarat Board-2022 (July)

2. Read the passage given below and answer the questions that follow:

Aldehydes, ketones and carboxylic acids are some of the important classes of organic compounds containing carbonyl group. These are highly polar molecules due to higher electro-negativity of oxygen relative to carbon in the carbonyl group. Aldehydes are prepared by dehydrogenation or controlled oxidation of primary alcohols and controlled reduction of acyl halides. Ketones are prepared by oxidation of secondary alcohols and hydration of alkynes. Aldehydes and ketones undergo nucleophilic addition reactions onto the carbonyl group but carboxylic acid does not undergo nucleophilic addition reaction. The alpha (α) – hydrogens of aldehydes and ketones are acidic. Therefore aldehydes and ketones having at least one α -hydrogen undergo Aldol condensation.

Aldehydes are easily oxidised by mild oxidizing agents such as Tollen's reagent and Fehling's reagent. Carboxylic acids are prepared by the oxidation of primary alcohols, aldehydes and by hydrolysis of nitriles. Aromatic carboxylic acids are prepared by side-chain oxidation of alkyl benzenes. Carboxylic acids are considerably more acidic than alcohols and most of simple phenols.

(a) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction. :

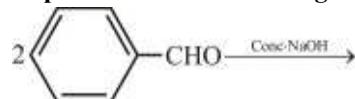


(b) Give a simple chemical test to distinguish between Ethanal and Propanone.

(c) Why carboxylic acid does not give nucleophilic addition reactions like aldehydes and ketones ?

(d) (i) Why α -hydrogen of aldehydes and ketones are acidic in nature?

(ii) Write the products in the following:



CBSE-2022

3. (c) An organic compound (A) C_2H_4O reduces Tollen's reagent. (A) reacts with HCN followed by hydrolysis in acid medium gives (B) $C_3H_6O_3$ which is optically active compound (B) on reaction with Fenton's reagent forms (C) $C_3H_4O_3$. This answers iodoform reaction. Identify (A), (B) and (C). Write the reactions involved

Tamil Nadu Board-2015

Section-E : Long Answer

1. An organic compound 'A' contain 69.77% Carbon, 11.63% Hydrogen and rest is Oxygen. The molecular mass of the compound is 86. It does not reduce Tollen's Reagent but forms an additional compound with Sodium Hydrogen Sulphite and gives positive Iodoform test. On vigorous oxidations it gives Ethanoic acid and Propenoic acid. Write the possible structure of compound. 'A' and also give chemical reactions.

Uttarakhand Board-2020

2. An organic compound A(C_7H_8) on oxidation by air in the presence of V_2O_5 at 773 K gives B(C_7H_6O), which reduces Tollen's reagent. B when heated with acetic anhydride and sodium acetated gives C($C_9H_8O_2$). Identify A, B and C. Write the reactions.

Tamil Nadu Board-2011

3. Compound A (C_2H_4O) reduces Tollen's reagent. A on treatment with zinc amalgam and conc. HCl gives compound B. In presence of conc. H_2SO_4 A forms a cyclic structure C which is used as hypnotic. Identify A, B and C Explain the reactions.

Tamil Nadu Board-2011

4. (a) How will you distinguish between Pentan-2-one and pentan-3-one with the help of Iodoform test ?
- (b) How will you bring about following conversions ?
- (a) Benzoic acid to m-Nitrobenzyl alcohol.
 - (ii) Benzaldehyde to Benzophenone.
 - (iii) Benzoic acid to Benzamide.

Haryana Board-2019

5. Write labelled chemical equations to show what happens when:
- Sodium propionate is heated with sodalime.
 - Acetone reacts with sodiumhypoiodite.
 - Benzaldehyde reacts with a nitrating mixture.
 - Ethanenitrile reacts with stannous chloride and HCl followed by hydrolysis.

Goa Board-2018

6. Identify 'X', 'Y' and 'Z' in the following :
- $\text{CH}_3.\text{CH}_2.\text{OH} \xrightarrow{\text{conc. H}_2\text{SO}_4/443\text{K}} \text{'X}' \xrightarrow[\text{Alkaline KMnO}_4]{\text{H}_2\text{O}+\text{O}} \text{'Y}'$
 - $\text{CH}_3.\text{CHBr}.\text{CH}_3 \xrightarrow{\text{KOH(aq)}} \text{'X}' \xrightarrow[\text{Peroxide}]{\text{HBr}} \text{'Y}' \xrightarrow{\text{CH}_3\text{ONa}} \text{'Z}'$

Jharkhand Board-2018

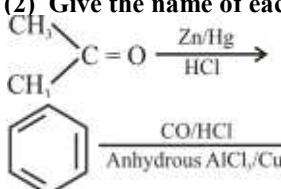
7. How would you account for the following :
- Aldehydes are more reactive than ketones towards nucleophilic addition reaction.
 - Boiling point of aldehydes are lower than alcohols.
 - Addition reaction of sodium hydrogen sulphite is useful for separation and purification of aldehydes.

Kerala Board-2018

8. Discuss the structure of Carbonyl group.
Haryana Board-2017

9. Aldehydes, Ketones and Acids contain C=O group.

- Name the product obtained by the reaction between Acetic acid and Ethanol.
- (i) Give any two test to distinguish between aldehydes and ketones.
- (ii) Two chemical reactions are given below.
- (1) Identify the products of each reaction.
- (2) Give the name of each reaction.



Kerala Board-2015

10. Compound (A) also known as blue vitriol can be prepared by dissolving Cupric oxide in dil H_2SO_4 . A on heating to 230°C gives compound B which is colourless. A reacts with excess of NH_4OH and gives C which is a complex salt. A also reacts with H_2S and gives compound D, a precipitate which is black in colour. Find out A,V,C and D. Explain the reactions.

Tamilnadu Board, Sep.-2016

11. An organic compound contains 69.77% carbon, 11.63% hydrogen and rest oxygen. The molecular mass of the compound is 86. It does not reduce Tollens' reagent but forms an addition compound with sodium hydrogensulphite and give positive iodoform test. On vigorous oxidation it gives ethanoic and propanoic acid. Identify the compound and write equations for chemical reactions involved.

Assam Board-2020

12. An organic compound with the molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms 2, 4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1, 2-benzenedicarboxylic acid. Identify the compound.

Assam Board-2019

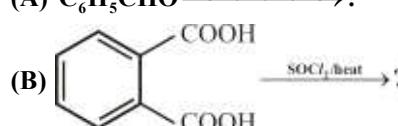
13. An organic compound X($\text{C}_2\text{H}_4\text{O}$), on oxidation, gives Y($\text{C}_2\text{H}_4\text{O}_2$). Compound (X) undergoes haloform reaction. On treatment with HCN, compound (X) produces Z which on hydrolysis, gives 2-Hydropropanoic acid. Identify X, Y and Z. Write the equation for the reactions involved. What happens when X is treated with dilute NaOH?

Assam Board-2017

14. An organic compound contains 69.77% carbon, 11.63% hydrogen and the rest is oxygen. The molecular mass of the compound is 86u. The compound does not reduce Tollens reagent but reacts with Brady's reagent to give yellow precipitate. On vigorous oxidation the molecule produces ethanoic acid and propanoic acid. The compound also shows iodoform test. Identify and name the compound, and write the reactions.

Assam Board-2013

- 15.a. (i) Describe the following reactions and give the reaction involved in it.
 (A) Aldol condensation
 (B) Etard reaction.
 (ii) What is Fehling's solution test?
 OR
 b. (i) What happens when acetone reacts with HCN?
 (ii) Complete the following reactions:
 (A) $\text{C}_6\text{H}_5\text{CHO} \xrightarrow{\text{H}_2\text{NCONHNH}_2} ?$



Nagaland Board-2020

E. Nomenclature of Carboxyl Group

Section-A : Multiple Choice Questions

1. What is common name of $\text{HOOC-(CH}_2)_3-\text{COOH}$?
 (a) Malonic acid (b) Succinic acid
 (c) Glutaric acid (d) Adipic acid

Gujarat Borad-2022 (July)

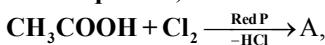
Ans. (c)

2. The isomerism exhibited by $\text{CH}_3\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{COOCH}_3$ is
 (a) Metamerism
 (b) Position
 (c) Chain
 (d) Functional

Tamil Nadu Board-2011

Ans. (d)

4. In the equation,

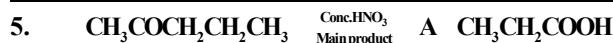


The compound A is

- (a) $\text{CH}_3\text{CH}_2\text{Cl}$ (b) ClCH_2COOH
 (c) CH_3Cl (d) CH_3COCl

ISC Board-2016

Ans. (b)



What will be A?

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ (b) CH_3COOH
 (c) HCOOH (d) $\text{CH}_3\text{CH}_2\text{COOH}$

Gujarat Board-2019

Ans. (b)

Section-B : Very Short Answer

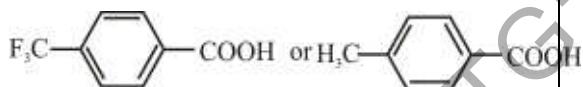
1. How will you obtain- (Give equations only)-
 (i) Benzene from benzoic acid

UP Board 2019

2. How will you obtain- (Give equations only)-
 (i) Benzoic acid from phenyl cyanide?

UP Board 2019

3. Which acid of the following pair is a stronger acid?



Gujarat Board 2023 (July)

4. Among formic acid and acetic acid, which is weaker acid and why?

Karnataka board 2023

5. Give reason:

- (i) chloroacetic acid is stronger than acetic acid.
 (ii) pH of reaction should be carefully controlled while preparing ammonia derivatives of carbonyl compounds.

Delhi 2013C

6. Write the reactions involved in the following:

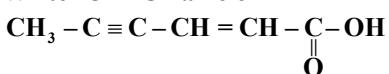
- (i) Hell-Volhard Zelinsky reaction
 (ii) Decarboxylation reaction

Delhi 2017

7. Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Give two reasons.

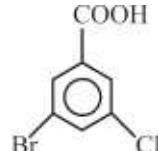
Delhi 2013

8. Write IUPAC name of



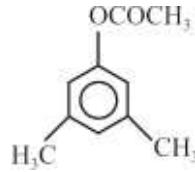
Delhi 2011, 2008C

9. Write IUPAC name of



All India 2011C

10. Write IUPAC name of



Delhi 2011C

11. Illustrate the following reaction giving a suitable example: Decarboxylation

Delhi 2012

12. Complete the following reaction:



Delhi 2013C

13. How will you carry out the following conversion?
 Acetic acid to propionic acid

ISC Board -2002

14. Write the balanced chemical equation for the following reaction:

- (a) Oxalic acid is treated with acidified potassium permanganate solution.
 (b) Benzoic acid is treated with a mixture of concentrated nitric acid and concentrated sulphuric acid.
 (c) Methyl magnesium iodide is treated with carbon dioxide and the product hydrolysed in acidic medium.

ISC Board-2013

15. How will you distinguish between the following pair of compounds? Give one good chemical test.

Oxalic acid and acetic acid.

ISC Board-2009

16. Carry out the following conversion:
 Methyl chloride to acetic acid.

ISC Board-2011

17. Carry out the following conversion:
 Benzene to benzoic acid.

ISC Board-2007, 2011

18. Give one good chemical test to distinguish between the following pair of compounds:
 Oxalic acid and benzoic acid.

ISC Board-2010

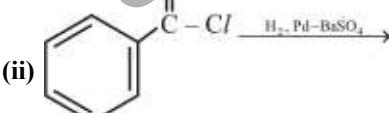
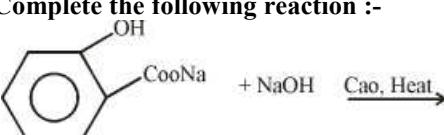
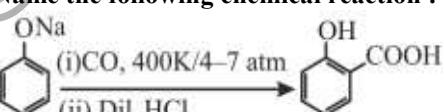
19. How will you carry out the following conversion?

Acetic acid to methane

ISC Board-2002

20. How can the following conversion be brought about?
 Propanoic acid to ethylamine.

ISC Board-2013

21. How can the following conversion be brought about?
Benzoic acid to benzaldehyde.
ISC Board-2013
22. Write the equation and name of the following reaction:
Acetic acid with red phosphorus and chlorine.
ISC Board-2004
23. Starting with Grignard's reagent, how will you prepare propanoic acid?
ISC Board-2016
24. The aqueous solution of sodium acetate is basic. Explain.
ISC Board-2015
25. Give the balanced equation for the following reaction:
Kolbe's electrolytic reaction
ISC Board-2014
26. Give the balanced equation for the following reaction:
Benzoic acid and phosphorus pentachloride.
ISC Board-2012
27. Give the balanced equation for the following name reaction. Benzoin condensation
ISC Board-2016
29. Write reasons for the following statements :
 (i) Benzoic acid does not undergo Friedel-Crafts reaction.
 (ii) Oxidation of aldehydes is easier than that of ketones.
CBSE-2022
30. Out of the following pairs, predict with reason which will allow greater conduction of electricity :
 (i) 1M CH_3COOH solution or 0.1M CH_3COOH solution on dilution.
 (ii) Copper wire at 27° or copper wire at 50°C.
CBSE-2022
31. Write the major products of the following reactions :
 (i) 
 (ii) 
- CBSE-2022
32. Arranged the following in the increasing order of their property indicated :
 (a) Ethanal, Propanone, Propanal, Butanone (reactivity towards nucleophilic addition)
 (b) 4-Nitrobenzoic acid, benzoic acid, 3,4-Dinitrobenzoic acid, 4-Methoxy benzoic acid (Acid strength)
CBSE-2022
33. Account for the following :
 (a) Aromatic carboxylic acids do not undergo Friedel-Crafts reaction.
 (b) pK_a value of 4-nitrobenzoic acid is lower than that of benzoic acid.
UP Board-2018
34. How are Carboxylic acids prepared from nitrites?
Karnataka Board-2014
35. Explain the preparation of carboxylic acids from Grignard reagent. Give equation.
Karnataka Board-2018
36. Complete the following reaction :-

- Punjab Board-2017
37. Give reason why aromatic carboxylic acids do not undergo Friedel – Crafts reactions.
Goa Board-2018
38. How are carboxylic acids prepared from Grignard reagent?
Karnataka Board-2015
39. An aqueous solution of CH_3COONa is —due to _____.
ISC Board-2017
40. Which series of compounds can be prepared by oxidation of primary alcohols?
Rajasthan Board-2016
41. Name the following chemical reaction :

- Assam Board-2023
42. Write the structure of 5-chloro-4-methoxy-2-nitrobenzoic acid.
Meghalaya Board-2018

Section-C : Short Answer

1. If benzoic acid ($M = 122 \text{ g mol}^{-1}$) is associated into a dimer when dissolved in benzene and the osmotic pressure of a solution of 6.1 g of percentage association of benzoic acid? (Given: $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)
Gujarat Board 2023 (July)
2. Do the following conversions is not more than two steps:
 (i) Toluene to Benzoic acid
Gujarat Board 2023 (July)
3. Write chemical equation to prepare salicylic acid from phenol.
Rajasthan Board 2023
4. A compound A ($\text{C}_2\text{H}_6\text{O}$) on oxidation by PCC gave B, which on treatment with aqueous alkali and subsequent heating furnished C. B on oxidation by KMnO_4 , forms a monobasic carboxylic acid with molar mass 60 g mol^{-1} . Deduce the structures of A, B and C.
All India 2011C

5. Two moles of organic compound A on treatment with a strong base gives two compounds B and C. Compound B on dehydrogenation with Cu gives A while acidification of C yields carboxylic acid D with molecular formula of CH_2O_2 . Identify the compounds A, B, C and D and write all chemical reactions involved.

Delhi 2013

6. An organic compound (A) which has characteristic odour, on treatment with NaOH forms two compounds (B) and (C). Compound (B) has the molecular formula $\text{C}_7\text{H}_8\text{O}$ which on oxidation with CrO_3 gives back compound (A). Compound (C) when heated with soda lime yields an aromatic hydrocarbon (D). Deduce the structures of (A), (B), (C) and (D). Write chemical equations for all reaction taking place.

All India 2013C, 2012C

7. An organic compound (A) with molecular formula $\text{C}_8\text{H}_8\text{O}$ forms an orange red precipitate with 2, 4-DNP reagent and gives yellow precipitate on heating with I_2 and NaOH . It neither reduce Tollens' reagent nor Fehling's reagent, nor does it decolourise bromine water or Baeyer's reagent. On drastic oxidation with chromic acid, it gives a carboxylic acid (B) having molecular formula $\text{C}_7\text{H}_6\text{O}_2$. Identify the compounds (A) and (B) and explain the reactions involved.

Delhi 2012C

8. An organic compound A (molecular formula $\text{C}_8\text{H}_{16}\text{O}_2$) was hydrolysed with dilute sulphuric acid to give a carboxylic acid B and an alcohol C. Oxidation of C with chromic acid also produced B. On dehydration C gives but-1-ene. Write the equations for the reactions involved.

Foreign 2010; Delhi 2010,
2008; All India 2009

9. An organic compound A contains 69.77% carbon, 11.63% hydrogen and rest oxygen. The molecular mass of the compound is 86. It does not reduce Tollen's reagent but forms an addition compound with sodium hydrogen sulphite and gives positive iodoform test. On vigorous oxidation, it gives ethanoic acid and propanoic acids. Derive the structure of compound A.

All India 2009; Delhi 2009,
2008; Foreign 2009, 2008

10. Give reason for the following statements : (Any two)

- (i) Benzaldehyde is less reactive than propanal in nucleophilic addition reactions.
- (ii) Carboxylic acids do not give reactions of carbonyl group.
- (iii) 4-nitrobenzoic acid is a stronger acid than benzoic acid than benzoic acid.

CBSE-2022

11. Arrange the following compounds in the increasing order of their property indicated : (Any two)

(i). Acetaldehyde, Benzaldehyde, Acetophenone, Acetone (Reactivity towards HCN)

(ii) $(\text{CH}_3)_2\text{CHCOOH}$, $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{COOH}_2\text{COOH}$ (acidic strength)

(iii) $\text{CH}_3\text{CH}_2\text{OH}$, CH_3CHO , CH_3COOH (Boiling point)

CBSE-2022

12. (i) Which acid of the following pair would you expect to be stronger ?

$\text{F}-\text{CH}_2-\text{COOH}$ or CH_3-COOH

(ii) Arrange the following compounds in increasing order of their boiling points :

$\text{CH}_3\text{CH}_2\text{OH}$, CH_3-CHO , CH_3-COOH

(iii) Give simple chemical test to distinguish between Benzaldehyde and Acetophenone.

CBSE-2022

13. Predict the reagent for carrying out the following transformations : (Any two)

(i) Benzoyl chloride to Benzaldehyde

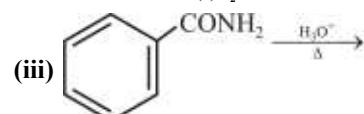
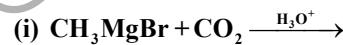
(ii) Ethanal to 3-hydroxy butanal

(iii) Ethanoic acid to 2-chloroethanoic acid

CBSE-2022

Ans. (c)

14. Predict the products in the following reactions :



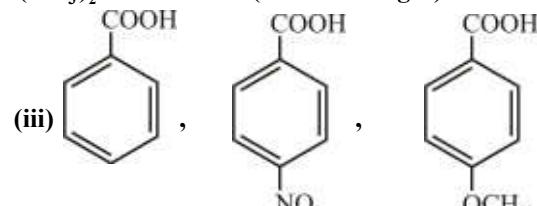
- (b) Arrange the following compounds in increasing order of their property as indicated :

(i) $\text{CH}_3\text{CHO}, \text{CH}_3\text{CH}_2\text{CHO}, \text{CH}_3-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{CH}_2-\text{CH}_3$,

$\text{CH}_3-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{CH}_3$ (Reactivity towards HCN)

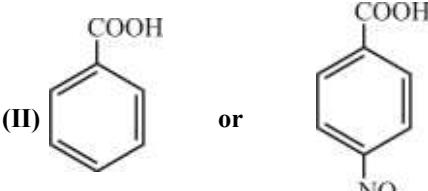
(ii) $\text{CH}_3\text{COOH}, \text{Cl}-\text{CH}_2-\text{COOH}$,

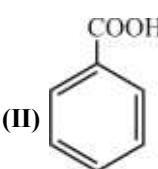
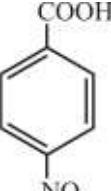
$(\text{CH}_3)_2\text{CH}-\text{COOH}$ (Acidic strength)



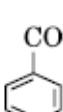
(Acidic strength)

CBSE-2022

15. (b) (i) Which acid of each pair would you expect to be stronger ?
(Give reason.)
(I) F – CH₂ – COOH or Cl – CH₂ – COOH


 (II)
 (II) 
 or

- (ii) Distinguish between Propanal and Propanone.
- CBSE-2022
16. Convert the following :
 (i) Benzoic acid to Benzaldehyde
 (ii) Propan-1-ol to 2-Bromopropanoic acid
 (iii) Acetaldehyde to But-2-enal
- CBSE-2022
17. What is Hell-Volhard-Zelinsky (HVZ) reaction ?
- Chhattisgarh Board-2023
18. State the reactions to prepare carboxylic acid from amide, acid chloride and anhydride.
- Gujarat Board-2016
19. (a) How is acetic acid prepared from methyl magnesium bromide? what happens when it reacts with (i) Na₂CO₃ (ii) C₂H₅OH in the presence of conc. H₂SO₄?
 (b) Write the IUPAC name of
- $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{COOH} \\ | \\ \text{CH}_3 \end{array}$
- Odisha Board-2023
20. identify the reaction in which sodium or potassium salt of a carboxylic acid, on electrolysis, gives a higher alkane. What product will be formed if CH₃CH₂COONa is used in this reaction? Write the reactions involved.
- NIOS Board-2013
21. (a) Write Hell Volhard-Zelinsky (H.V.Z.) reaction.
 (b) Why are the boiling points of carboxylic acids higher than the corresponding alcohols ?
 (c) Why aldehydes are more reactive than ketones ?
- Punjab Board-2019
22. (i) Write Hell-Volhard-Zelinsky reaction.
 (ii) Write cross aldol condensation.
 (iii) Ethanoic acid is weaker acid than benzoic acid. Why ?
- Punjab Board-2017
23. Define Osmosis
 How will you determine molar mass of non volatile solute by elevation of boiling point ?
- Maharashtra board-2023
24. Name the method used for the manufacture of this acid.
- Kerala Board-2021
25. Aldehydes, Ketones and acids contain >C=O group.
 Choose the IUPAC name of the compound (CH₃)₂CHCOOH
 (i) Butanoic acid
 (ii) Ethanoic acid
 (iii) 2-methyl propanoic acid
 (iv) propanoic acid
 (a) Complete the following reaction:
 (i) CH₃CH₂COOH $\xrightarrow{\text{LiAlH}_4/\text{Ether}}$
 (ii) CH₃CH₂COOH + SOCl₂ \rightarrow
 (iii) CH₃CH₂COOH $\xrightarrow{\text{Br}_2/\text{Red P}}$
 (iv) CH₃CH₂COOH + CH₃OH $\xrightleftharpoons{\text{H}^+}$
- Kerala Board-2016
26. How will you prepare R-COOH from?
 (i) Alcohol
 (ii) Nitrile
- Haryana Board-2017
- 27.(i) Give equations for the following preparations:
 (a) Acetamide from acetyl chloride.
 (b) Methyl cyanide from acetamide.
- Rajasthan Board-2010
28. Write the major and minor product of 'Bromination of anisole in ethanoic acid medium'.
- Assam Board-2019

Section-D : Case Based Study

1. (a) Carry out the following conversions :
 (i) P-nitrotoluene to 2-bromobenzoic acid
 (ii) Propanoic acid to acetic acid
 (b) An alkene with molecular formula C₅H₁₀ on ozonolysis gives a mixture of two compounds, B and C. Compound B gives positive Fehling test and also reacts with iodine and NaOH solution. Compound C does not give Fehling solution test but forms iodoform. Identify the compounds A, B and C.
- CBSE-2019
2. (a) Carry out the following conversions:
 (i) Benzoic acid to aniline
 (ii) Bromomethane to ethanol
 (b) Write the structure of major product(s) in the following :
- (i) $\text{CH}_3 - \text{CH}_2 - \underset{\text{O}}{\overset{\parallel}{\text{C}}} - \text{H}$ $\xrightarrow{\begin{array}{l} \text{(a) H}_2\text{N} - \text{NH}_2 \\ \text{(b) KOH, Glycol/heat} \end{array}}$
- (ii) $\text{CH}_3 - \underset{\text{CH}_3}{\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}} - \text{CHO}$ $\xrightarrow{\text{conc. NaOH}}$
- (iii)  $\xrightarrow{\text{NaOH}}$
- CBSE-2019

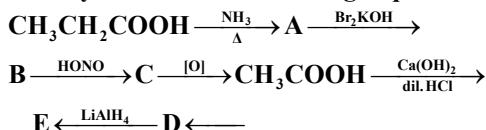
Section-E : Long Answer

1. Compound A ($C_6H_{12}O_2$) on reduction with $LiAlH_4$ yields two compounds B and C. The compound B on oxidation gave D which on treatment with aqueous alkali and subsequent heating furnished E.

The latter on catalytic hydrogenation gave C. The compound D on further oxidation gave CH_3COOH . Deduce the structures of A, B, C, D and E.

All India 2009C

2. Identify A to E in the following sequence:



All India 2009C

3. An organic compound A on treatment with ethyl alcohol gives a carboxylic acid B and compound C. Hydrolysis of C under acidified conditions gives B and D. Oxidation of D with $KMnO_4$ also gives B. B on heating with $Ca(OH)_2$ gives E having molecular formula C_3H_6O . E does not give Tollen's test and does not reduce Fehling's solution but forms a 2,4-dinitrophenylhydrazone. Identify A, B, C, D and E.

All India 2010C

4. An organic compound A on treatment with acetic acid in the presence of sulphuric acid produces an ester B. A on mild oxidation gives C. C with 50% KOH followed by acidification with dil. HCl generates A and D. D with PCl_5 followed by reaction with ammonia gives E. E on dehydration produces hydrocyanic acid. Identify the compounds A, B, C, D and E.

Delhi 2009C

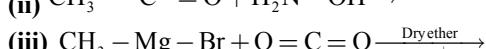
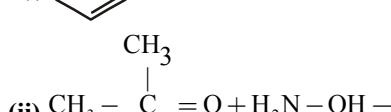
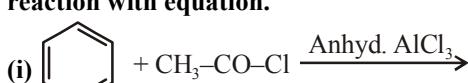
5. a) Write equation for:

- i) The reaction between Carboxylic acid and PCl_5 .
 ii) The reaction between formaldehyde and cone KOH.
 iii) The formation of oxime from carbonyl compound,
 b) Explain aldol condensation with an example.

Karnataka Board-2014

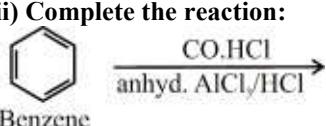
6. a) Write the organic compound formed in the following equations.

- b) Explain HVZ (Hell-Volhard-Zelinsky) reaction with equation.



Karnataka Board-2015

7. a) i) How do you convert benzoic acid to benzamide? Write the reaction.
 ii) Complete the reaction:



- b) What happens when carbonyl compounds are treated with hydrazine? Write the reaction.

3 + 2

Karnataka Board-2014

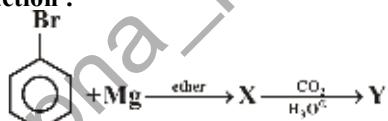
8. (i) What is the action of the following reagents on ethanoic acid?
 (a) $LiAlH_4 / H_3O^+$
 (b) PCl_3 , heat
 (c) P_2O_5 , heat

Maharashtra board-2018

Answer the following questions :

- (i) Arrange the following compounds in the decreasing order of their acidic strength :
 FCH_2COOH , CH_3COOH , $ClCH_2COOH$.

- (ii) Write structure of X and Y in the following reaction :



correction

- (iii) Write a chemical equation for the preparation of Methane from sodium acetate.

- (iv) Name the product formed when :

- (a) Toluene is oxidized using $KMnO_4$, KOH followed by hydrolysis
 (b) Acetyl chloride reacts with H_2 in presence of Pd and $BaSO_4$.

Goa Board-2019

10. (i) An organic compound 'A' (molecular formula, $C_6H_{10}O$) forms hydrazone and reduces Tollens' reagent. When treated with CH_3MgBr followed by hydrolysis 'A' gives a chiral compound 'B'. Compound 'B' on oxidation with potassium dichromate/acid gives compound 'C'. Compound 'C' undergoes haloform reaction and gives cyclopentane carboxylic acid as oxidation product. Identify A, B, C and write the sequence of the reactions.
 (ii) Write the mechanism of esterification reaction of benzoic acid with ethanol in the presence of concentrated sulphuric acid.

Manipur Board-2019

11. Describe the preparation of acetic acid through quick-vinegar process in following points:
 (i) Diagram
 (ii) Method
 (iii) Equation of preparation
 (iv) Any one precaution.

MP Board-2016

12. Explain the preparation of Acetic acid by quick vinegar process with diagram.

MP Board-2013

13. Explain the Quick Vinegar Process of the manufacture of Acetic Acid under the following headings:

- (a) Principle and Equation
(b) Labelled diagram.

MP Board-2012

14. (a) Show how each of the following compounds can be converted into benzoic acid?

- (i) Ethyl benzene
(ii) Acetophenone
(iii) Bromobenzene

J & K board-2023

15. Account for the following:

- (i) Electrophilic substitution in benzoic acid takes place at meta position
(ii) Chloroacetic acid is stronger than acetic acid

J & K board-2023

16. What are carboxylic acids? Give any four methods of preparation of carboxylic acids.

Or

Explain the following reactions by giving an example :

- (i) Aldol condensation
(ii) Wolf-Kishner reduction
(iii) Rosenmund reduction

J&K Board-2020

G. Chemical and Physical Properties of Carboxylic Acid

Section-A : Multiple Choice Questions

1. The correct order of reactivity of various carboxylic acid derivatives is :

- (a) Acid chloride < Acid anhydride < Ester < Amide
(b) Amide < Ester < Acid anhydride < Acid chloride
(c) Acid chloride < Acid anhydride < Ester < Amide
(d) Acid chloride < Ester < Acid anhydride < Amide

NIOS Board-2022

Ans. (b)

2. Among the following the strongest acid is:

- (a) ClCH_2COOH (b) Cl_3CCOOH
(c) CH_3COOH (d) CHCl_2COOH

Tamil Nadu Board-2016
Haryana Board-2016

Ans. (d)

3. Which order of arrangement is correct in terms of the strength of the acid?

- (a) $\text{CH}_3-\text{CH}_2\text{COOH} < \text{CH}_3\text{COOH} < \text{HCOOH}$
 $< \text{ClCH}_2\text{COOH}$
(b) $\text{CH}_3-\text{CH}_2\text{COOH} > \text{CH}_3\text{COOH} < \text{HCOOH}$
 $< \text{ClCH}_2\text{COOH}$
(c) $\text{HCOOH} > \text{CH}_3\text{CH}_2\text{COOH} < \text{CH}_3\text{COOH}$
 $> \text{ClCH}_2\text{COOH}$
(d) $\text{ClCH}_2\text{COOH} < \text{HCOOH} < \text{CH}_3\text{COOH}$
 $< \text{CH}_3\text{CH}_2\text{COOH}$

Tamil Nadu Board-2018

Ans. (a)

4. Which of following is stronger Acid :

- (a) HCOOH
(b) CH_3COOH
(c) $\text{CH}_3\text{CH}_2\text{COOH}$
(d) $(\text{CH}_3)_2\text{CHCOOH}$

Punjab Board-2019

Ans. (a)

5. Which among the followings is most acidic?

- (a) Acetic acid
(b) Formic acid
(c) Chloroacetic acid
(d) Ethanol

Punjab Board-2021

Ans. (b)

6. Terbutyl benzene $\xrightarrow{\substack{\text{(i) } \text{KMnO}_4/\text{KOH.} \\ \text{(ii) } \text{dil H}_2\text{SO}_4}}$?

- (a) Benzoic acid
(b) No reaction
(c) Tertbutyl benzoic acid
(d) Tertbutanol

Gujarat Board-2019

Ans. (b)

7. Among the following which is more acidic?

- (a) HCOOH
(b) $\text{CH}_3\text{CH}_2\text{COOH}$
(c) CH_3COOH
(d) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

Kerala Board-2020

Ans. (a)

8. Hoffman Bromamide degradation reaction involve:

- (a) $\text{Ar}-\text{NH}_2$ (b) $\text{Ar}-\text{CONH}_2$
(c) $\text{Ar}-\text{NO}_2$ (d) None of these

Haryana Board-2017

Ans. (b)

9. Acid anhydrides on reaction with 1° amine gives:

- (a) Amide (b) Imide
(c) Imine (d) None of these

Haryana Board-2017

Ans. (a)

10. Strongest acid is:

- of (a) $\text{p-ClC}_6\text{H}_4\text{COOH}$ (b) $\text{p-OHC}_6\text{H}_5\text{COOH}$
(c) $\text{C}_6\text{H}_5\text{COOH}$ (d) $\text{p-NO}_2\text{C}_6\text{H}_4\text{COOH}$

Haryana Board-2016

Ans. (c)

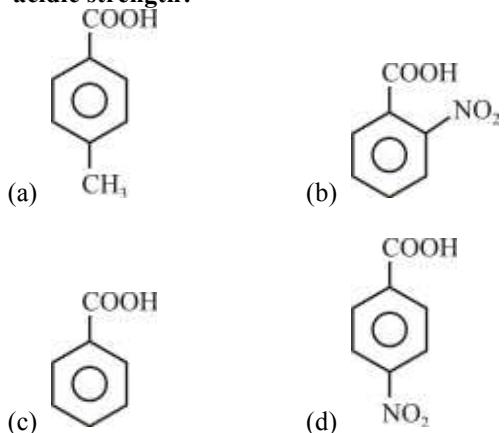
11. When $\text{CH}_3\text{CH}_2\text{CH}_2\text{COONa}$ heated with sodalime ($\text{NaOH} + \text{CaO}$), the hydrocarbon formed is:

- (a) Butane (b) Propane
(c) Hexane (d) Ethane

Haryana Board-2016

Ans. (b)

12. Which of the following compound has highest acidic strength?



Gujarat Board-2018

Ans.(b) :

13. Propanoic acid $\xrightarrow[\text{H}_2\text{O}]{\text{Cl}_2/\text{Red P}} \text{X}$.

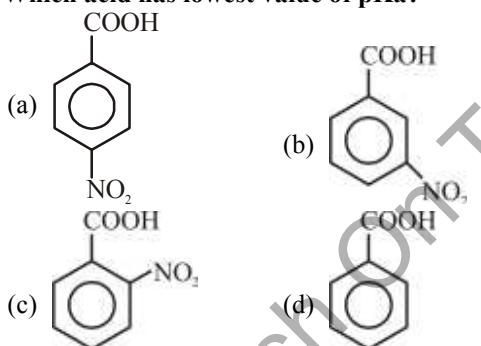
$$\text{X} = \underline{\quad}$$

- (a) Propanal
(b) Propanol
(c) Propane
(d) α -chloro propanoic acid

Gujarat Board-2017

Ans.(d)

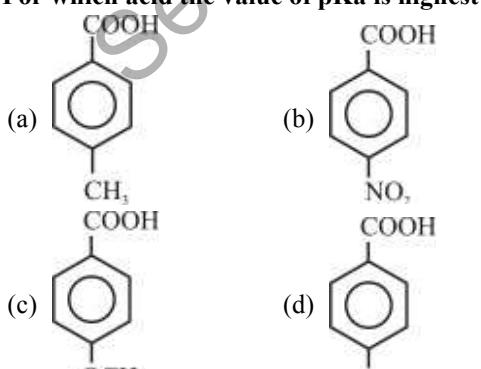
14. Which acid has lowest value of pK_a ?



Gujarat Board-2018

Ans. (c)

15. For which acid the value of pK_a is highest?



Gujarat Board-2019

Ans. (c)

Section-B : Very Short Answer

1. How will you obtain- (Give equations only)-

- (i) Ethyl formate from formic acid?

UP Board 2019

2. Arrange the following compounds in an increasing order of their property as indicated:

- (i) Benzoic acid, 3, 4-dinitrobenzoic acid, 4-methoxybenzoic acid (acidic strength)
(ii) $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{COOH}$, $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{COOH}$, $(\text{CH}_3)_2\text{CHCOOH}$ (acidic strength)

All India 2012

3. Arrange the following compounds in an increasing order of their indicated property

- (i) Benzoic acid, 4-nitrobenzoic acid, 3,4-dinitrobenzoic acid, 4-methoxy benzoic acid. (acidic strength).
(ii) $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{COOH}$, $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{COOH}$, $\text{CH}_3\text{CH}_2\text{COOH}$ (acidic strength).

All India 2009

4. State reasons for

- (i) monochloroethanoic acid is a weaker acid than dichloroethanoic acid.
(ii) benzoic acid is a stronger acid than ethanoic acid.

Foreign 2008; Delhi 2008

5. Arrange the following compounds in increasing order of their acidic strength $(\text{CH}_3)_2\text{CHCOOH}$, $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{COOH}$, $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{COOH}$.

Delhi 2008

6. How are the following conversions carried out:

- (a) Benzoic acid to Benzaldehyde
(b) Acetophenone to 2-Phenyl-Butan-2-ol

CBSE-2019

7. Benzoic acid does not give Friedel-Crafts reaction. Why ?

8. p-nitrobenzoic acid has lower pK_a value than benzoic acid. Why?

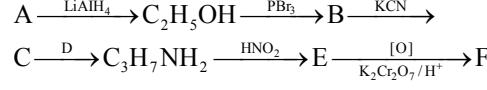
CBSE-2019

9. Arrange the following in increasing order of their acidic character :

Benzoic acid, Phenol, Cresol

CBSE-2019

10. Identify A to F.



ISC Board-2011

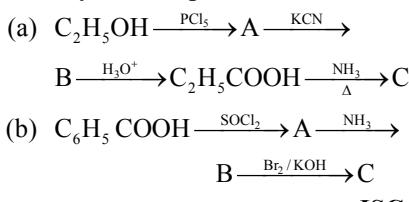
11. An aliphatic unsaturated hydrocarbon (A) when treated with $\text{HgSO}_4/\text{H}_2\text{SO}_4$ yields a compound (B) having molecular formula $\text{C}_3\text{H}_6\text{O}$. (B) on oxidation with concentrated HNO_3 gives two-compounds (C) and (D). Compound (C) when treated with PCl_5 gives compound (E). (E) when reacts with ethanol gives a sweet smelling

liquid (F). Compound (F) is also formed when (C) reacts with ethanol in the presence of concentrated H_2SO_4 .

- (a) Identify the compound A, B, C, D, E and F.
- (b) Give the chemical equation for the reaction of (C) with chlorine in the presence of red phosphorus and name the reaction.

ISC Board-2017

12. Identify the compounds A, B and C.

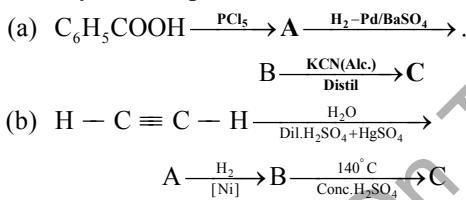


ISC Board-2016

13. An organic compound A has the molecular formula $\text{C}_7\text{H}_6\text{O}$. When A is treated with NaOH followed by acid hydrolysis, it gives two products B and C. When B is oxidised, it gives A, when A and C are each treated separately with PCl_5 , they give two different products D and E.
- (a) Identify A, B, C, D and E.
 - (b) Give the chemical reaction when A is treated with NaOH and name the reaction.

ISC Board-2016

14. Identify the compounds A, B and C:



ISC Board-2017

15. How can the following conversions be brought about?
- (a) Acetaldehyde to acetaldehyde phenyl hydrazone.
 - (b) Methyl chloride to acetone.

ISC Board-2016

16. How will you bring about the following conversion?

Formic acid to oxalic acid.

ISC Board-2003, 2008

17. Write the relevant equation to convert acetic acid to acetone.

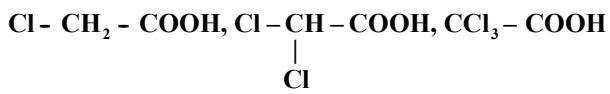
ISC Board-2006

18. (b) How will you bring about the following conversions?

- (I) Benzoic acid to Benzaldehyde
- (II) Propan-2-ol to Propanone

CBSE-2022

19. (a) Arrange the following compounds in the increasing order of their acidic strength :



- (b) Write the IUPAC name of the given compound:
 $\text{CH}_3\text{COCH}_2\text{COCH}_3$

CBSE-2022

20. Arrange the following in the increasing order of the property mentioned :

- (a) CH_3COOH , ClCH_2COOH , FCH_2COOH
 (Acid strength)
- (b) CH_3CHO , $\text{CH}_3\text{CH}_2\text{OH}$, $\text{CH}_3\text{CH}_2\text{CH}_3$
 (Boiling Points)

CBSE-2022

21. Write structures of main compounds A and B in each of the following reactions:



CBSE-2019

22. How are the following conversions carried out?

- (a) CH_3CN to CH_3COCH_3
- (b) Benzoic acid to Benzoyl chloride

CBSE-2019

23. Benzoic acid on treatment with Br_2 and FeBr_3 gives the compound (A), which on treatment with NH_3 gives the compound (B). The compound (B) on heating gives the compound (C). Write the structures of compounds (A), (B) and (C) in the above sequence of reactions.

Odisha Board-2020

24. What happens when a mixture of calcium formate and calcium acetate is dry distilled?

Odisha Board-2020

25. Arrange the following compounds in order of increasing acidic strength:



Manipur Board-2018

26. What is the action of ammonia $[\text{NH}_3]$ on benzoic acid. Write equation.

Karnataka Board-2017

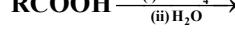
27. If the elemental analysis of butyric acid is found to be 54.2% C, 9.2% H and 36.6% O, determine its empirical formula.

NIOS Board-2022

28. Among methanoic acid and ethanoic acid which is more acidic and why?

Karnataka Board-2017

29. Complete the following reaction :



Chhattisgarh Board-2022

30. Among $\text{C}_6\text{H}_5\text{COOH}$ and $\text{CH}_3\text{CH}_2\text{COOH}$ which is a stronger acid and why?

Haryana Board-2016

31. How will you convert?

- (i) $\text{CH}_3\text{COOH} \longrightarrow \text{CH}_3-\text{CH}_3$
- (ii) $\text{CH}_3\text{COOH} \longrightarrow \text{CH}_3-\text{CH}_2-\text{OH}$
- (iii) $\text{C}_6\text{H}_5\text{COOH} \longrightarrow \text{C}_6\text{H}_5-\text{Br}-\text{COOH}$

Haryana Board-2017

32. Arrange benzoic acid, 4-methyl benzoic acid and 4-nitrobenzoic acid in increasing order of their acidic strength.

Rajasthan Board-2015

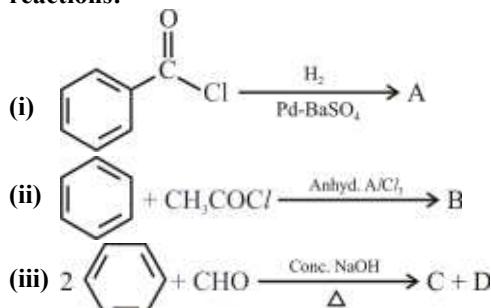
33. How will you convert sodium acetate to methane in one step?

Rajasthan Board-2014

34. Give the reaction of ammoniacal silver nitrate with Formic acid.

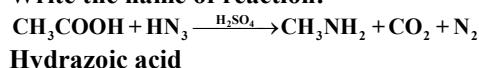
Tamilnadu Board, Sep.-2016

35. (b) Identify A, B, C and D in the following reactions:



Assam Board-2015

36. Write the name of reaction:



MP Board-2014

37. Complete the following reactions :



Nagaland Board-2021

Section-C : Short Answer

1. An organic compound (A) on treatment with ethyl alcohol gives a carboxylic acid (B) and a compound (C). Hydrolysis of (C) under acidic conditions gives (B) and (D). (B) upon heating with calcium hydroxide gives (E) $\text{C}_3\text{H}_6\text{O}$. (E) does not give Tollen's test but reacts with 2,4-DNP. Identify the structures of A, B, C, D and E.

CBSE-2019

2. (a) Give reasons for the following :

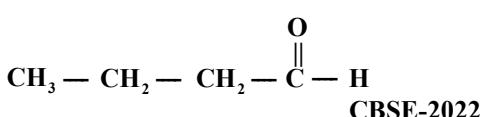
- (i) In semicarbazide, there are two-NH₂ groups, but only one is involved in the formation of semicarbazones.
(ii) Carboxylic acid is a stronger acid than phenol.
(iii) α -hydrogens of aldehydes and ketones are acidic in nature.

CBSE-2022

3. (a) Arrange the following compounds in the increasing order of their acidic character :

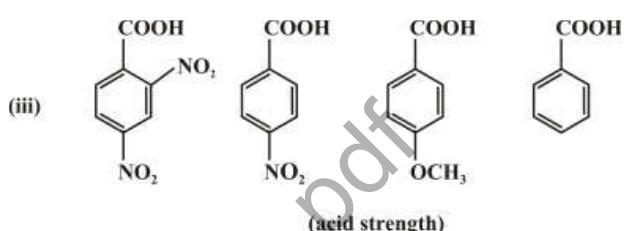
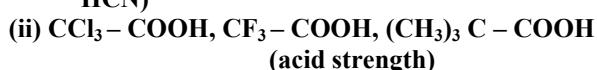
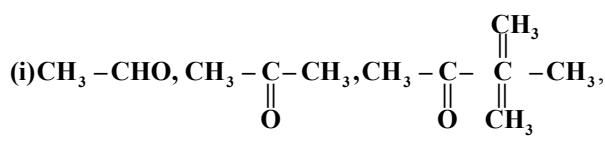


- (b) Write the IUPAC name of the given compound :



CBSE-2022

4. Arrange the following compounds in increasing order of their property as indicated in bracket : (Any two)



CBSE-2022

5. (c) Write two characteristics of non-ideal solution.
(d) 2 g of benzoic ($\text{C}_6\text{H}_5\text{COOH}$) dissolved in 25 g of benzene shows a depression in freezing point equal to 1.62 K. Molal depression constant for benzene is $4.9 \text{ K kg mol}^{-1}$. What is the percentage association of acid if it forms dimer in solution?

CBSE-2019

6. (a) Give IUPAC name of Salicylic acid.
(b) Chloroacetic acid is more acidic than acetic acid. Why ?
(c) Write the products formed when $(\text{CH}_3)_3\text{C}-\text{CHO}$ reacts with the following :
(i) Zinc amalgam and dilute hydrochloric acid
(ii) Concentrated sodium hydroxide solution
(iii) Semicarbazide and a weak acid

CBSE-2019

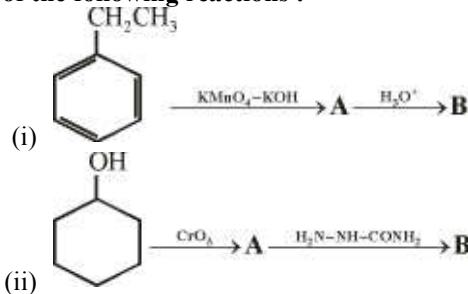
7. (a) Give reasons:
(i) Benzoic acid is a stronger acid than acetic acid.
(ii) Methanal is more reactive towards nucleophilic addition reaction than ethanal.
(b) Give a simple chemical test to distinguish between propanal and Benzoic acid is a stronger acid than acetic acid. propanone.

CBSE-2019

8. Answer the following :
(a) Why is ester hydrolysis slow in the beginning and then becomes faster after some time ?
(b) In a solution of methylene blue, animal charcoal is added, the solution is then well be observed and why?
(c) Give an example of oil in water emulsion.

CBSE-2019

9. Write structures of compounds A and B in each of the following reactions :



CBSE-2019

10. Answer the following :

- Why is ester hydrolysis slow in the beginning and then becomes faster after some time ?
- In a solution of methylene blue, animal charcoal is added, the solution is then well shaken. What will be observed and why ?
- Give an example of oil in water emulsion.

CBSE-2019

11. Which of the following compounds can undergo Hell-Volhard-Zelinsky reaction?

- Benzoic acid
- Propanoic acid

Assam Board-2022

12. State the preparation of ester, amide and anhydride from carboxylic acid.

Gujarat Board-2016

13. How is oxalic acid manufactured from sodium formate?

Tamil Nadu Board-2015

14. Account for reducing nature of Formic acid.

Tamil Nadu Board-2015

15. How to do the following conversions?

- Lactic acid to lactide
- Salicylic acid to methyl salicylate.

Tamil Nadu Board-2011

16. Discuss the optical isomerism in tartaric acid.

Tamil Nadu Board-2011

17. Give tow tests for carboxylic acids.

Tamil Nadu Board-2016

18. Write notes on cit-trans isomerism with suitable example.

Tamil Nadu Board-2018

19. What is the indicator used for the titration between oxalic acid and sodium hydroxide? Justify your answer with suitable reason.

Tamil Nadu Board-2018

20. Determine the empirical formula of butyric acid. Its elemental composition is as follows : C = 54. 2 %, H = 9. 2 %, O = 36. 6 %

If the molecular mass of butyric acid is 88 u, then find its molecular formula.

[Atomic mass : C = 12 u, H = 1 u, O = 16 u]

NIOS Board-2016

21. Monochloroacetic acid is stronger than acetic acid. Why ?

Chhattisgarh Board-2022

22. Identify A, B and C in the following sequence of reaction



Kerala Board-2019

23. Give balanced equations for the following reactions:

- Acetic anhydride with phosphorous pentachloride.

ISC Board-2017

24. Give balanced equation for the following name reactions:

- Aldol condensation

ISC Board-2017

25. Identify the compounds A, B and C:



ISC Board-2017

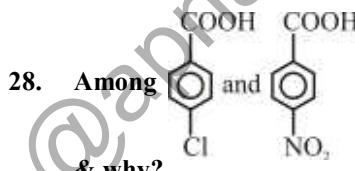
26. Which one of the following compounds would undergo Hell-Volhard-Zelinsky reaction and why?

- Benzoic acid.
- Propanoic acid.

Assam Board-2014

27. What is Hell-Volhard-Zelinsky reaction?

Haryana Board-2017

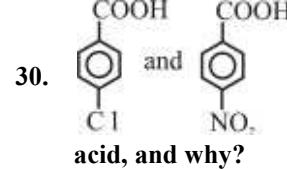


Haryana Board-2016

29. Compare the acidic strength of following acids:

- CH_3COOH
- HCOOH
- $\text{C}_6\text{H}_5\text{COOH}$

Haryana Board-2018



Haryana Board-2018

31. Giving an example for each describe the following reactions:

- Hofmann's Bromamide Reaction
- A coupling reaction

Haryana Board-2018

32. Convert benzene into:

- Benzaldehyde
- Phenyl acetic acid
- Methyl benzoate

Haryana Board-2018

- 33.(a) Arrange the following haloacids in increasing order of their acidity.

Cl_3CCOOH , Cl_2CHCOOH , ClCH_2COOH .

- (b) Why carboxylic acids are more acidic than phenol?

Rajasthan Board-2020

- 34.(a) Arrange the following haloacids in increasing order of their acidity.
 FCH_2COOH , ClCH_2COOH , BrCH_2COOH .
- (b) Aldehydes are more reactive than ketones towards nucleophilic addition reactions. Explain.
- Rajasthan Board-2020
35. Alkanoic acid have highest boiling points. Explain.
- Rajasthan Board-2018
36. Arrange the following carboxylic acid in ascending order of their acidity. Benzoic acid, 4-methoxybenzoic acid, 4-nitrobenzoic acid.
- Rajasthan Board-2018
37. Write the equation of chemical reaction and name of reaction to obtained following compounds (A) and (B) from CH_3COOH .
- (a) Ethone
(b) Mono chloroacetic acid
- Rajasthan Board-2017
38. Chloroacetic acid is stronger acid than acetic acid. Give one reason.
- Rajasthan Board-2017
39. Give chemical reaction to obtain the following.
- (i) Carboxylic acid from Grignard reagent.
(ii) Benzoic acid from ethyl benzoate.
(iii) Benzamide from benzoic acid.
- Rajasthan Board-2016
40. Give resonating structures of propenoic acid?
- Rajasthan Board-2016
41. Boiling point of carboxylic molecular masses. why?
- Rajasthan Board-2015
42. Draw the dimer structure of ethanoic acid in vapour state.
- Rajasthan Board-2015
43. Why is fluroacetic acid more acidic than chloroacetic acid ?
- Rajasthan Board-2015
44. Draw the resonating structures of carboxylate ion.
- Rajasthan Board-2015
45. Write Hofmann's bromamide reaction.
- Rajasthan Board-2014
46. Identify X and Y in the following reaction sequence and also write the names of the two reactions involved:
- $\text{R-CONH}_2 \xrightarrow{\text{Br}_2/\text{NaOH}} \text{X} \xrightarrow{\text{CHCl}_3/\text{KOH(alc.)}} \text{Y}$
- Rajasthan Board-2013
- 47.(a) How carboxylate ion get stabilized by resonance? Explain by the structures.
(b) Carboxylic acids are more acidic than phenols. Explain.
- Rajasthan Board-2013
48. Fluoroacetic acid is more acidic than acetic acid. Explain.
- Rajasthan Board-2010
49. Give the resonance structure of acetamide.
- Rajasthan Board-2010
50. Give equations for the following preparations:
- (a) Acetic acid from acetaldehyde.
(b) Acetic anhydride from acetic acid.
- Rajasthan Board-2010
51. What is trans esterification? Give example.
- Tamilnadu Board, Sep.-2016
52. Arrange the following compounds in increasing order of their acid strength:
 $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{COOH}$, $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{COOH}$, $(\text{CH}_3)_2\text{CHCOOH}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
- Assam Board-2020
53. Write chemical reactions to affect the following transformations (any three)
- (i) Butan-1-ol to butanoic acid.
(ii) Cyclohexene to hexane-1, 6-dioic acid.
(iii) Butanal to butanoic acid
(iv) Ethanoic acid to ethanoic anhydride.
- Assam Board-2018
54. Arrange the following in increasing order of acidity:
 CH_3COOH , $\text{CH}_3\text{CH}_2\text{COOH}$,
 $\text{C}_6\text{H}_5\text{COOH}$, $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$
- Assam Board-2017
55. Arrange the following in increasing order of pKa values:
 CH_3COOH , ClCH_2COOH , Cl_2CHCOOH , Cl_3CCOOH
- Assam Board-2016
56. What happen when (Give only equation).
- (i) Acetone reacts with conc. H_2SO_4 .
(ii) Benzoic acid reacts with SOCl_2 .
(iii) Acetic acid reacts with ammonia.
(iv) Acetic acid reacts with caustic soda.
- MP Board-2017
57. What happens when:
- (i) Acetal chloride is reduced with hydrogen in presence of Barium sulphate associated with palladium.
(ii) Benzaldehyde boils with 45% NaOH .
(iii) Ammonia reacts with Formaldehyde.
(iv) Acetic-Acid reacts with- PCl_5 .
- MP Board-2016
58. How will you obtain:
- (i) Formic acid from Acetic acid.
(ii) Acetaldehyde from Acetylene.
- MP Board-2013

Section-D : Case Based Study

1. True /False
- vi. The C-X bond length in halobenzene is smaller than C-X bond length in $\text{CH}_3\text{-X}$ (T/F)
- vii. Alcohols are weaker acids than water (T/F)
- viii. Carboxylic acids are more acidic than phenols. (T/F)
- ix. Keratin is fibrous protein (T/F)
- x. Aliphatic Amines are more basic than NH_3 (T/F)

Punjab Board-2021

Section-E : Long Answer

1. What happens when benzoic acid reacts with
 (i) conc. HNO_3 /conc. H_2SO_4
 (ii) $\text{Cl}_2/\text{FeCl}_3$
 (iii) PCl_5

Tamil Nadu Board-2011

2. How is lactic acid synthesised from acetylene?
 How can it be converted into cyclic diester?

Tamil Nadu Board-2011

3. Give a brief account of the following .
 (i) Kolbe's electrolytic reaction
 (ii) HVZ reaction
 (iii) Friedel Crafts Acylation

Tamil Nadu Board-2016

4. The K_a of propionic acid is 1.34×10^{-5} . What is the pH of a solution containing 0.5 M Propionic acid and 0.5 M sodium Propionate?

Tamil Nadu Board-2018

5. Explain the isomerism exhibited by carboxylic acids.

Tamil Nadu Board-2018

6. Give suitable reaction to show that trans esterification is an alcoholysis reaction.

Tamil Nadu Board-2018

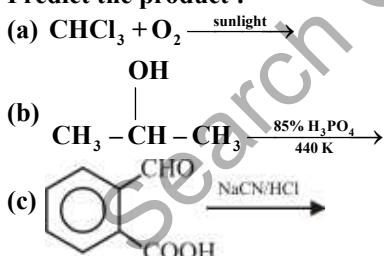
7. $\text{C}_7\text{H}_7\text{ON} \xrightarrow[\text{KOH}]{\text{Br}_2} \text{B} \xrightarrow{\text{COCl}_2} \text{C}$. Identify A, B and C
 (A)

Tamil Nadu Board-2018

8. (a) Identify the groups with -1 and +1 effects from the following species :
 $-(\text{CH}_3)_3\text{C}$ – NO_2 – C_2H_5 and C_6H_5
 (b) Arrange the following with decreasing order of reactivity with alcohols. Give also suitable reason.
 R_3CCOOH , CH_3COOH , R_2CHCOOH , RCH_2COOH

NIOS Board-2022

9. Predict the product :



Jharkhand Board-2018

11. (a) What happens when:
 (i) Formaldehyde is treated with conc. KOH solution.
 (ii) Benzoyl chloride treated with hydrogen in presence of Pd-BaSO_4 .
 (b) Compare the acidic strength of the following:
 (i) $\text{C}_6\text{H}_5\text{COOH}$
 (ii) HCOOH
 (iii) CH_3COOH

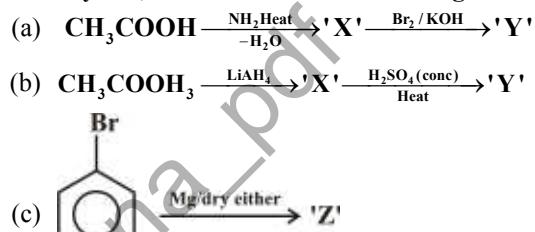
Haryana Board-2016

12. An aliphatic unsaturated hydrocarbon (A) when treated with $\text{HgSO}_4/\text{H}_2\text{SO}_4$ yields a compound (B) having molecular formula $\text{C}_3\text{H}_6\text{O}$. (B) on oxidation with concentrated HNO_3 gives two compounds (C) and (D). Compound (C) when treated with PCl_5 gives compound (E). (E) when reacts with ethanol gives a sweet smelling liquid (F). Compound (F) is also formed when (C) reacts with ethanol in the presence of concentrated H_2SO_4 .

- (i) Identify the compound A, B, C, D, E and F.
 (ii) Give the chemical equation for the reaction of (C) with chlorine in the presence of red phosphorous and name the reaction.

ISC Board-2017

13. Identify 'X', 'Y' and 'Z' in the following :



Jharkhand Board-2020

14. What is decarboxylation? Explain with an example.

Haryana Board-2017

- 15.(a) Explain the optical activity of Tartaric acid.
 (b) How do succinic acid reacts with the following
 (a) NaOH
 (b) NH_3
 (c) PCl_5

Tamilnadu Board, Sep.-2016

16. Explain the reaction mechanism of bromine with salicylic acid.

Tamilnadu Board, Sep.-2016

17. What is the action of heat on Oxalic acid and Succinic acids

Tamilnadu Board, March-2016

18. Write the mechanism involved in the bromination of salicylic acid.

Tamilnadu Board, March-2016

19. Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Why?

Assam Board-2020

20. Explain Hofmann reaction with two examples.

Gujarat Board-2019

21. What is Raoult's Law?

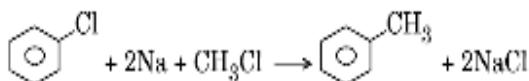
Drive Raoult's Law for solution which contain non-volatile solute.

MP Board-2012

H. Uses of Aldehydes, Ketones and Carboxylic Acids

Section-A : Multiple Choice Questions

1. The reaction given below:



is called:

- (a) Wurtz reaction
- (b) Wurtz – Fittig reaction
- (c) Fittig reaction
- (d) None of the above

CBSE-2021

Ans. (b)

2. Anisole is used in:

- (a) Refrigerant
- (b) Anaesthetic
- (c) Perfumery
- (d) Substitute for petrol

Tamil Nadu Board-2015

Ans. (c)

3. Which of the following reactions is most suitable for the preparation of n - propylbenzene?

- (a) Freidel – Crafts alkylation
- (b) Wurtz reaction
- (c) Wurtz – Fittig reaction
- (d) Grignard reaction.

Manipur Board-2017

Ans. (c)

4. In Clemmensen reduction the reducing agent used is

- (a) Na/ethanol
- (b) Zn-Hg/HCl
- (c) Mg-Hg/H₂O
- (d) LiAlH₄

Punjab Board-2021

Ans. (b)

5. Which substance used in leather industry?

- (a) Benzoic acid
- (b) Acetic acid
- (c) Methanoic acid
- (d) Pentanoic acid

Gujarat Board-2019

Ans. (c)

6. $\text{C}_6\text{H}_5\text{CHO} + \text{CH}_3\text{CHO} \xrightarrow{\text{dil.NaOH}} \text{C}_6\text{H}_5\text{C}=\text{HCHO}$
is called :

- (a) Claisen Condensation
- (b) Benzoin Condensation
- (c) Perkin Reaction
- (d) Cannizaro reaction

NIOS Board-2022

Ans. (a)

7. The compound found in some stony deposit in kidneys is:

- (a) Potassium oxalate
- (b) Oxalic acid
- (c) Potassium succinate
- (d) Calcium oxalate

Tamilnadu Board, March-2016

Ans. (d)

8. Which compound is used as urinary antiseptic?

- (a) Benzoic acid
- (b) Malonic acid
- (c) Ethanoic acid
- (d) Adipic acid

Gujarat Board-2018

Ans. (a)

9. Which carboxylic is present in vinegar?

- (a) Benzoic Acid
- (b) Ethanoic Acid
- (c) Methanoic Acid
- (d) Oxalic Acid

Gujarat Board-2020

Ans. (b) : j

10. Tollen's reagent is

- (a) mixture of CuSO₄ and NaOH
- (b) ammonical silver nitrate solution
- (c) a solution of copper sulphate, sodium citrate and sodium carbonate
- (d) anhydrous ZnCl₂ and conc. HCl

Jharkhand Board-2023

Ans. (b)

Section-B : Very Short Answer

1. Give simple chemical tests to distinguish between the following pairs of compounds:

- (i) Ethanal and propanal.
- (ii) Benzoic acid and phenol.

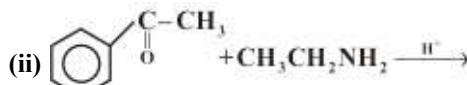
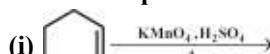
Delhi 2013

2. Give chemical tests to distinguish between the following pairs of compounds:

- (i) Propanal and propanone.
- (ii) Benzaldehyde and benzoic acid.

Delhi 2012

3. Predict the products.



All India 2011C

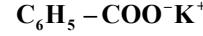
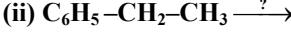
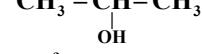
4. Give chemical tests to distinguish between

- (i) ethanol and propanol.

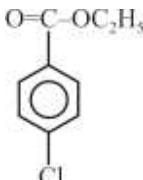
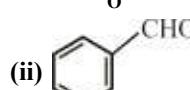
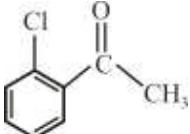
- (ii) benzoic acid and ethyl benzoate .

Delhi 2010

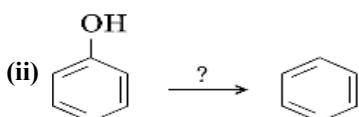
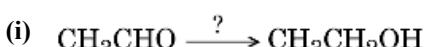
5. Name the reagents used in the following reactions.



All India 2015

6. Write the reagents required in the following reactions:
- (i) $\text{CH}_2 = \text{CH}-\text{CH}_2\text{OH} \xrightarrow{\quad} \text{CH}_2 = \text{CH}-\text{CHO}$
- (ii) $\text{CH}_3-\text{COOH} \xrightarrow{\quad} \text{CH}_3-\text{CONH}_2$
- Delhi 2015
7. How will you carry out the following conversions?
- (i) Acetylene to acetic acid
- (ii) Toluene to m-nitrobenzoic acid
- Delhi 2013C
8. How will you convert benzoic acid to benzaldehyde?
- Delhi 2010; All India 2009
9. Write the IUPAC name of
- 
- All India 2009C
10. Illustrate the following name reaction giving suitable example;
Hell-Volhard-Zelinsky reaction.
- Delhi 2012; Foreign 2012
11. How would you complete the following conversion? Write the complete equation.
Benzoic acid to m-nitorbenzyl alcohol.
- Foreign 2012
12. Give chemical tests to distinguish between phenol and benzoic acid.
- Delhi 2012, 2010
13. Write the equations involved in the following reactions:
- (i) Wolff-Kishner reduction.
- (ii) Etard reaction.
- Delhi 2017
14. Write the reactions involved in the following reactions:
- (i) Clemmensen reduction
- (ii) Cannizzaro reaction
- Delhi 2017
15. How are the following conversions carried out?
- (i) Propene to propan-2-ol.
- (ii) Ethyl chloride to ethanal.
- Foreign 2014
16. Complete the following reactions:
- (i) $2\text{H}-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{H} \xrightarrow{\text{Conc. KOH}}$
- (ii)  $\xrightarrow[\text{273-283 K}]{\text{HNO}_3/\text{H}_2\text{SO}_4}$
- Delhi 2013
17. How will you convert bromobenzene to 1-phenylethanol?
- All India 2009
18. What is Tollen's reagent? Write one usefulness of this reagent.
- All India 2010
19. Write the IUPAC name of the following:
- 
- All India 2010C
20. Illustrate the name reaction:
Wolff-Kishner reduction.
- All India 2010
21. Illustrate the following reaction giving a suitable example:
Cross aldol condensation.
- Delhi 2012
22. Give simple tests to distinguish between the following pair of compounds:
Pentan-2-one and pentan-3-one
- Delhi 2012
23. Illustrate the following name reaction giving suitable example:
Clemmensen reduction
- Delhi 2012, 2009, 2008;
All India 2011, 2010
24. Give chemical test to distinguish between benzophenone and acetophenone.
- Delhi 2012
25. How will you carry out the following conversion?
Ethanol to acetone
- Delhi 2013C
26. Define with equation :
- (a) Riemer-Tiemann Reaction
- (b) Williamson's Synthesis
- CBSE-2019
27. An organic compound A has the molecular formula $\text{C}_7\text{H}_6\text{O}$. When A is treated with NaOH followed by acid hydrolysis, it gives two products, B and C. When B is oxidised, it gives A. When A and C are each treated separately with PCl_3 , they give two different organic products D and E.
- (a) Identify A to E.
- (b) Give the chemical reaction when A is treated with NaOH and name the reaction.
- ISC Board-2011
28. Write the equations involved in the following reactions:
- (i) Hoffmann bromamide degradation.
- (ii) Diazotisation
- CBSE-2021

29. Write the name of reagent(s) used in the following reactions:



CBSE-2021

30. How is benzoic acid converted to benzaldehyde?

Odisha Board-2017

31. What is Rosenmund's reduction? Give equation.

Odisha Board-2020

32. How do you convert the following?

- (a) Ethanal to Propanone
- (b) Toluene to Benzoic acid

UP Board-2018

33. What is Rosenmund reduction? Give equation.

Odisha Board-2023

34. A Compound A($\text{C}_2\text{H}_4\text{O}$) on oxidation gives B($\text{C}_2\text{H}_4\text{O}_2$). The compound A undergoes halo form reaction and reacts with dilute NaOH to yield C. C on subsequent heating gives D and D on catalytic hydrogenation gives E. Write the reaction involved and identify A, B, C, D and E

Manipur Board-2018

35. Write a brief account of the following with one suitable example of each.

- (a) Wurtz Fitting reaction
- (b) Ullmann reaction.

Manipur Board-2018

36. How is nitrobenzene converted to benzenediazonium chloride?

Manipur Board-2017

37. How is acetophenone converted to benzoic acid?

Manipur Board-2017

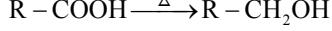
38. Explain sulphonation of benzene. Give chemical equation.

NIOS Board-2023

39. Write the general equation for Wurtz reaction.

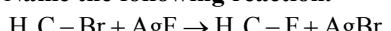
Karnataka Board-2019

40. What is the reagent 'A' used in the following equation?



Karnataka Board-2019

41. Name the following reaction.



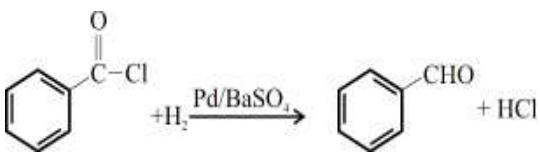
Karnataka Board-2018

42. What is action of dil NaOH on ethanol (acetaldehyde)?

Name the reaction.

Karnataka Board-2016

43. Name the following reaction.



Karnataka Board-2015

44. Explain Rosenmund's reduction of benzoyl chloride.

Karnataka Board-2014

45. $\text{H}_3\text{C}-\text{Br} + \text{AgF} \rightarrow \text{H}_3\text{C}-\text{F} + \text{AgBr}$. Name the reaction.

Karnataka Board-2014

46. Tollens reagent is

Haryana Board-2022

47. Write Wolff-Kishner's reduction for the conversion of Carbonyl group into -CH₂-group.

Karnataka Board-2020

48. $\text{R}-\text{X} + \text{NaI} \xrightarrow[\text{Acetone}]{\text{dry}} \text{R}-\text{I} + \text{NaX}$
What is the name of reaction?

Karnataka Board-2015

49. Which oxidising agent used in Etard-reaction?

Karnataka Board-2015



Name the above reaction.

Karnataka Board-2019

51. What is Nessler's reagent?

Maharashtra board-2019

52. Explain Haloform reaction.

Kerala Board-2019

53. Write the chemical equation representing Reimer - Tiemann reaction.

Kerala Board-2019

54. Explain Mendius reaction.

Chhattisgarh Board-2021

55. Briefly describe Gattermann Koch reaction.

Kerala Board-2018

56. How the following conversion can be carried out-

- (a) D.D.T. from Chlorobenzene
- (b) Diphenyl from Chlorobenzene

Uttarakhand Board-2019

57. Explain the terms :

- (a) Enantiomers (b) Racemisation

Andhra Pradesh Board-2016

58. Explain the following reactions :

- (a) Carbylamine reaction
- (b) Sandmeyer reaction

Andhra Pradesh Board-2016

59. Write only the structure of the major product formed when ethanal reacts with each of the following reagents:

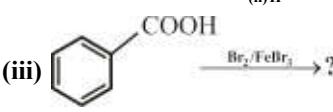
- (a) HCN
- (b) Zn-Hg/conc. HCl

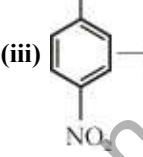
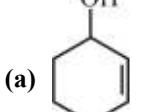
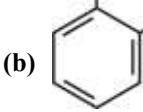
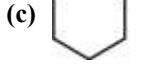
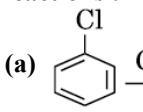
Goa Board-2019

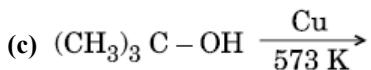
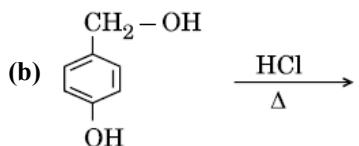
60. Explain Fittig reaction with an example.

Andhra Pradesh Board-2021

Section-C : Short Answer

1. Describe how the following conversions can be brought about?
 (i) Cyclohexanol to cyclohexan-1-one
 (ii) Ethyl benzene to benzoic acid.
 (iii) Bromobenzene to benzoic acid
All India 2010; Delhi 2008
2. Write structures of compounds A, B and C in each of the following reactions:
 (i) $\text{C}_6\text{H}_5\text{Br} \xrightarrow{\text{Mg/dry ether}} \text{A} \xrightarrow[\text{(b)}{\text{H}_3\text{O}^+}]{\text{CO}_2(\text{g})}$
 (ii) $\text{CH}_3\text{CN} \xrightarrow[\text{(b)}{\text{H}_3\text{O}^+}]{\text{(a)}\text{SnCl}_2/\text{HCl}} \text{A} \xrightarrow{\text{dil. NaOH}}$
 $\text{B} \xrightarrow{\Delta} \text{C}$
Delhi 2017
3. Do the following conversions in not more than two steps:
 (i) Benzoic acid to benzaldehyde.
 (ii) Ethyl benzene to benzoic acid.
 (iii) Propanone to propene.
Delhi 2017
4. Predict the products of the following reactions:
 (i) $\text{CH}_3 - \underset{\text{CH}_3}{\text{C}} = \text{O} \xrightarrow{\text{H}_2\text{N-NH}_2} ?$
 (ii) $\text{C}_6\text{H}_5 - \text{CH}_3 \xrightarrow[\text{(ii)}{\text{H}^+}]{\text{(i)}\text{KMnO}_4/\text{KOH}} ?$
 (iii)  $\xrightarrow{\text{Br}_2/\text{FeBr}_3} ?$
All India 2015
5. Predict the products of the following reactions:
 (i) $\text{CH}_3 - \underset{\text{CH}_3}{\text{C}} = \text{O} \xrightarrow[\text{(ii)}{\text{KOH/glycol, } \Delta}]{\text{(i)}\text{H}_2\text{N-NH}_2} ?$
 (ii) $\text{C}_6\text{H}_5 - \text{CO} - \text{CH}_3 \xrightarrow{\text{NaOH/I}_2} ? + ?$
 (iii) $\text{CH}_3\text{COONa} \xrightarrow[\Delta]{\text{NaOH/CaO}} ?$
Delhi 2015
6. How do you convert the following?
 (i) Benzoic acid to benzaldehyde.
 (ii) Ethyne to ethanal.
 (iii) Acetic acid to methane.
Foreign 2015
7. How are the following conversions carried out?
 (i) Ethyl cyanide to ethanoic acid
 (ii) Butan-1-ol to butanoic acid
 (iii) Benzoic acid to m-bromobenzoic acid
Delhi 2012C
8. (i) Illustrate the following reaction giving suitable chemical equations:
 Cannizzaro reaction
 (ii) How would you bring about the following conversions? Write the complete equations in each case.
 (a) Ethanal to 3-hydroxybutanal
 (b) Benzaldehyde to benzophenone
Foreign 2012

9. Write the equations involved in the following reactions:
 (i) Stephen reaction.
 (ii) Wolff-Kishner reaction.
 (iii) Etard reaction.
Foreign 2015
10. How will you bring about the following conversions?
 (i) Propanone to propane.
 (ii) Benzoyl chloride to benzaldehyde.
 (iii) Ethanal to But-2-enal.
Delhi 2013
11. Write the structure of the main products of following reactions:
 (i)  $+ \text{C}_6\text{H}_5\text{COCl} \xrightarrow[\text{CS}_2]{\text{Anhy. AlCl}_3} ?$
 (ii) $\text{H}_3\text{C} - \text{C} \equiv \text{C} - \text{H} \xrightarrow{\text{Hg}^{2+}, \text{H}_2\text{SO}_4} ?$
 (iii)  $\xrightarrow[\text{(ii)}{\text{H}_3\text{O}^+}]{\text{(i)}\text{CrO}_3/\text{Cl}_2} ?$
Delhi 2012
12. How can you convert the following?
 (i) Phenol to o-hydroxybenzaldehyde.
 (ii) Methanal to ethanol
 (iii) Phenol to phenyl ethanoate.
CBSE-2020
13. Write the product(s) of the following reactions:
 (a)  $\xrightarrow{\text{PCC}} ?$
 (b)  $\xrightarrow[\text{CH}_3\text{COOH}]{(\text{CH}_3\text{CO})_2\text{O}} ?$
 (c)  $+ \text{CH}_3\text{MgBr} \xrightarrow{\text{H}_3\text{O}^+} ?$
CBSE-2020
14. How can you convert the following?
 (i) But-1-ene to 1-iodobutane
 (ii) Benzene to acetophenone
 (iii) Ethanol to propanenitrile
CBSE-2020
15. Write the major product (s) of the following reactions:
 (a)  $\xrightarrow[\Delta]{\text{Conc. H}_2\text{SO}_4} ?$



CBSE-2020

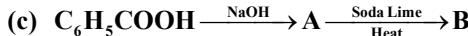
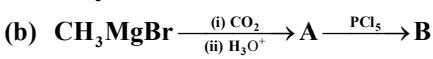
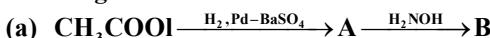
16. (a) Write the mechanism of the following reaction :



- (b) Write the preparation of phenol from cumene.

CBSE-2020

17. Write the structures of A and B in the following



CBSE-2020

18. What is Schmidt reaction? Write the structure of the product of this reaction.

Odisha Board-2017

19. What is Stephen's reduction reaction? give equation.

Odisha Board-2017

20. What is Benzoin condensation? Give equation.

Odisha Board-2017

21. How is eurotropine prepared ? Mention its use.

Tamil Nadu Board-2011

22. Mention the uses of oxalic acid

Tamil Nadu Board-2011

23. (a) Write the reactions involved in the following :

(i) Hofmann bromamide degradation reaction

(ii) Diazotisation

(iii) Gabriel phthalimide synthesis

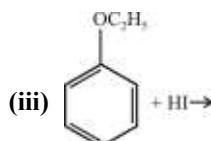
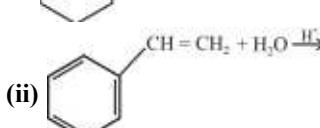
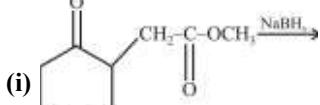
(b) Give reasons :

(i) $(\text{CH}_3)_2\text{NH}$ is more basic than $(\text{CH}_3)_3\text{N}$ in an aqueous solution.

(ii) Aromatic diazonium salts are more stable than aliphatic diazonium salts.

UP Board-2018

24. Write the structures of the main products in the following reactions :



UP Board-2018

25. Give the chemical equations for each of the following reactions:

(a) Hofmann bromamide reaction

(b) Carbylamine reaction.

Manipur Board-2017

26. Give simple chemical test to distinguish between :

(i) ethane and ethyne

(ii) Chloroethane and chlorobenzene

NIOS Board-2019

27. How will you carry out the following conversions?

(i) Aniline to benzene

(b) Propane-1-ol to 1-chloropropane

NIOS Board-2023

28. How will you carry out the following conversions?

(a) Chlorobenzene to Toluene

(b) Decanol to Decanal

NIOS Board-2021

29. How will you carry out the following conversions:

(i) Phenyl magnesium bromide to benzoic acid

(ii) Benzene to aniline

NIOS Board-2019

30. how is lactic acid manufactured by fermentation method?

Tamil Nadu Board-2016

31. How is oxalic acid prepared by?

(i) Laboratory method

(ii) Industrially from sodium formate

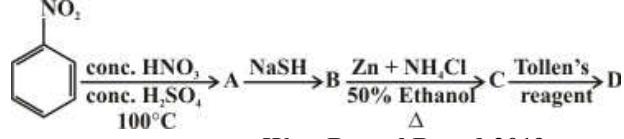
Tamil Nadu Board-2018

32. Explain the use of radioactive isotopes in the study of mechanism of photosynthesis in plants and hydrolysis of esters.

Tamil Nadu Board-2018

33. (i) Convert aniline to fluorobenzene.

(ii) Write structural formula of the compounds A to D :



West Bengal Board-2019

34. (a) Write the following reaction :

(i) Wurtz Fittig Reaction

(ii) Balz-Schiemann Reaction

(iii) Friedal Crafts Alkylation Reaction

(b) Why solubility of Haloalkanes in water is very low ?

(c) Give one use of Feron.

Punjab Board-2019

35. (a) Write Reimer-Tiemann's reaction
 (b) How will you convert Chlorobenzene to Phenol ?
 (c) Why Phenol are more acidic than Alcohol ?

Punjab Board-2019

36. How will you carry out the following conversions? Give chemical reactions only:
 (i) Phenol to 2, 4, 6-tribromophenol
 (ii) Phenylethanoic acid to 3-phenyl ethanol

NIOS Board-2023

37. (a) Explain the following reactions with a example:
 (i) Stephen reaction
 (ii) Etard reaction

Haryana Board-2016

38. Describe the following:
 (a) Carbylamine reaction
 (b) Coupling reaction

Haryana Board-2016

39. (a) How would you convert the following:
 (i) Phenol to Benzene
 (ii) Phenol to Benzoquinone
 (iii) Propene to propan-2-ol
 (b) How will you distinguish between benzyl alcohol & phenol.

Haryana Board-2016

40. Describe the following:
 (i) Wurtz Fittig reaction
 (ii) Sandmeyers reaction

Haryana Board-2016

41. How can the following conversions be effected?
 (i) Ethanol \longrightarrow Fluoroethane
 (ii) But - 1-ene \longrightarrow But - 2-ene

Kerala Board-2019

42. Give two important uses of carboxylic acids.

Haryana Board-2017

43. Describe Reimer-Tiemann reaction with an example. What will be the acidity of the product as compare to the substrate ?

Manipur Board-2019

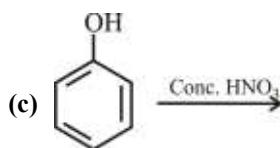
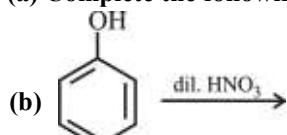
44. Write two methods to carry out the conversion of CH_3CHO to CH_3COCH_3 .

Manipur Board-2022

46. (a) Explain the following reactions :
 (i) Reimer-Tiemann reaction
 (ii) Williamson synthesis
 (b) Describe the following :
 (i) Cannizaro reaction
 (ii) Decarboxylation

Andhra Pradesh Board-2016

48. (a) Complete the following



Kerala Board-2016

49. Explain the following
 (a) Esterification
 (b) Williamson Synthesis

Kerala Board-2016

50. How will you distinguish aldehyde, ketone & carboxylic acid.

Rajasthan Board-2016

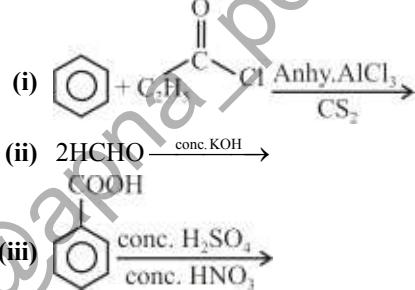
51. Mention the uses of formic acid.

Tamilnadu Board, March-2016

52. Mention one use of methanoic acid.

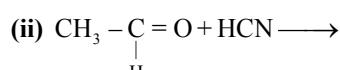
Assam Board-2017

53. (b) Complete the following reactions:



Meghalaya Board-2021

- 54.(a)Write the structures of the products of the following reactions:

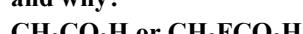


OR

- (b) Carboxylic acids are higher boiling liquids than aldehydes, ketones and even alcohols of comparable molecular masses. Why?

Meghalaya Board-2021

55. Which acid in the following pair is stronger and why?



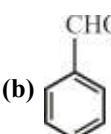
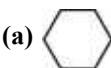
Meghalaya Board-2021

56. Both carboxylic acid and alcohol can form intermolecular hydrogen bonding. But the boiling point of carboxylic acid is more than that of corresponding alcohol. Why ?

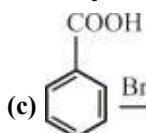
Assam Board-2023

57. (a) Give the chemical equation for the reaction of ethanol with conc. H_2SO_4 at 440 K.
 (b) Convert phenol to salicylic acid (2-hydroxybenzoic acid).

Meghalaya Board-2018

11. (i) Describe the following by giving chemical equations:
 (a) Decarboxylation reaction
 (b) Friedel-Crafts reaction
 (ii) How will you bring about the following conversions?
 (a) Benzoic acid to benzaldehyde
 (b) Benzene to m-nitroacetophenone
 (c) Ethanol to 3-hydroxybutanal
- Delhi 2015C
12. (i) Describe the following reactions.
 (a) Acetylation (b) Aldol condensation
 (ii) Write the main product in the following equations:
 (a) $\text{CH}_3 - \underset{\text{O}}{\overset{\parallel}{\text{C}}} - \text{CH}_3 \xrightarrow{\text{LiAlH}_4} ?$

 (b) $\text{C}_6\text{H}_5\text{CHO} \xrightarrow[273-283 \text{ K}]{\text{HNO}_3/\text{H}_2\text{SO}_4} ?$
 (c) $\text{CH}_3 - \text{COOH} \xrightarrow{\text{PCl}_5} ?$
- Delhi 2015C
13. (i) Write the products of the following reactions:
 (a)  + $\text{H}_2\text{N}-\text{OH} \xrightarrow{\text{H}^+} ?$
 (b) $2\text{C}_6\text{H}_5\text{CHO} + \text{conc. NaOH} \rightarrow ?$
 (c) $\text{CH}_3\text{COOH} \xrightarrow{\text{Cl}_2/\text{P}} ?$
 (ii) Give simple chemical tests to distinguish between the following pairs of compounds:
 (a) Benzaldehyde and benzoic acid
 (b) Propanal and propanone
- Delhi 2014
14. (i) Account for the following:
 (a) CH_3CHO is more reactive than CH_3COCH_3 towards reaction with HCN
 (b) Carboxylic acid is a stronger acid than phenol
 (ii) Write the chemical equations to illustrate the following name reactions:
 (a) Wolff-Kishner reduction
 (b) Aldol condensation
 (c) Cannizzaro reaction
- All India 2014
15. (i) Write the products formed when CH_3CHO reacts with the following reagents:
 (a) HCN (b) $\text{H}_2\text{N}-\text{OH}$
 (c) CH_3CHO in the presence of dilute NaOH
 (ii) Give simple chemical tests to distinguish between the following pairs of compounds:
 (a) Benzoic acid and phenol
 (b) Propanal and propanone
- All India 2014; Delhi 2013C
16. (i) Account for the following:
 (a) $\text{Cl} - \text{CH}_2\text{COOH}$ is a stronger acid than CH_3COOH .
 (b) Carboxylic acids do not give reactions of carbonyl group
- (ii) Write the chemical equations to illustrate the following name reactions.
 (a) Rosenmund reduction
 (b) Cannizzaro's reaction
 (iii) Out of $\text{CH}_3\text{CH}_2-\text{CO}-\text{CH}_2-\text{CH}_3$ and $\text{CH}_3\text{CH}_2-\text{CH}_2-\text{CO}-\text{CH}_3$, which gives iodoform test?
- Delhi 2014
17. (i) Account for the following:
 (a) CH_3CHO is more reactive than CH_3COCH_3 towards reaction with HCN.
 (b) There are two $- \text{NH}_2$ groups in semicarbazide ($\text{H}_2\text{NNHCONH}_2$). However, only one is involved in the formation of semicarbazone.
 (ii) Write the chemical equation to illustrate each of the following name reactions:
 (a) Rosenmund reduction
 (b) Hell-Volhard-Zelinsky reaction
 (c) Cannizzaro reaction
- Foreign 2014
18. (i) Write the IUPAC names of the following compounds:
 (a) $\text{CH}_3\text{CO}(\text{CH}_2)_4\text{CH}_3$
 (b) $\text{Ph} - \text{CH} = \text{CH} - \text{CHO}$
 (ii) Describe the following conversions in not more than two steps:
 (a) Ethanol to 3-hydroxybutanal
 (b) Benzoic acid to m-nitrobenzyl alcohol
 (c) Propanone to propene
- Delhi 2014
19. (i) Draw the structures of the following compound:
 (a) 4-chloropentan-2-one
 (b) p-nitropropiophenone
 (ii) Give tests to distinguish between the following pairs of compound:
 (a) Ethanal and propanal
 (b) Phenol and benzoic acid
 (c) Benzaldehyde and acetophenone
- All India 2014C
20. (i) Draw the structures of the following compounds:
 (a) 4-chloropentan-2-one
 (b) But-2-en-1-al
 (ii) Write the product(s) in the following:
 (a) $\text{CH}_3 - \text{COOH} \xrightarrow{\text{Br}_2/\text{P}} ?$
 (b) $\text{CH}_3 - \text{CHO} \xrightarrow{\text{LiAlH}_4} ?$
 (c) $\text{CH}_3 - \underset{\text{O}}{\overset{\parallel}{\text{C}}} - \text{CH}_3 \xrightarrow[\text{conc. HCl}]{\text{Zn-Hg}} ?$
- Foreign 2014
21. (i) How will you convert the following:
 (a) Propanone to propan-2-ol?
 (b) Ethanal to 2-hydroxypropanoic acid?
 (c) Toluene to benzoic acid?
 (ii) Give simple chemical tests to distinguish between
 (a) pentan-2-one and pentan-3-one
 (b) ethanal and propanal
- All India 2013

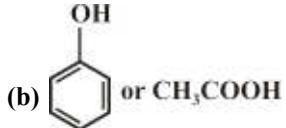
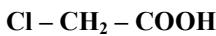
22. (i) Predict the products



(ii) Which acid of each pair shown here would you expect to be stronger?

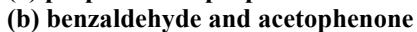
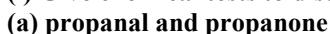


OR

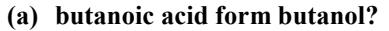


Delhi 2012

23. (i) Give chemical tests to distinguish between

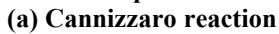


(ii) How would you obtain



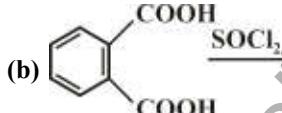
Delhi 2011, Foreign 2011; all India 2008

24. (i) Describe the following giving linked chemical equations:



All India 2010; Delhi 2008

(ii) Complete the following chemical equations:

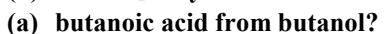


Delhi 2011, 2008; foreign 2011

25. (i) Illustrate the following name reaction.

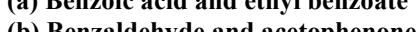
Cannizzaro's reaction

(ii) How would you obtain

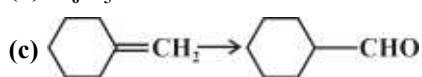
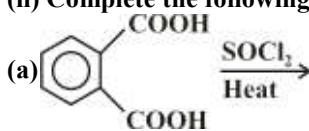


All India 2011; Delhi 2009

26. (i) Give chemical tests to distinguish between the following:

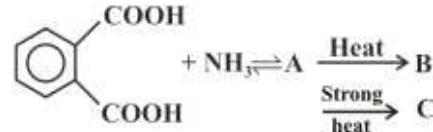


(ii) Complete the following:

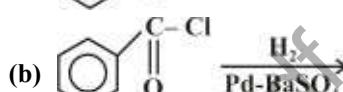
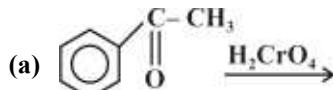


All India 2011; Foreign 2010

27. Identify A, B and C in the sequence



(ii) Predict the products of the following reactions:

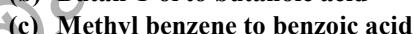


Delhi 2011C

28. (i) Illustrate the following name reactions:

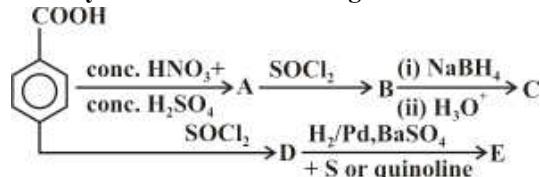
Hell-Volhard-Zelinsky reaction

(ii) How are the following conversions carried out?



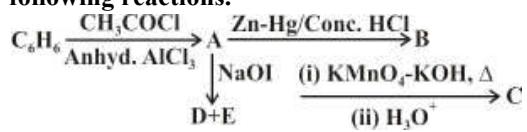
All India 2010

29. Identify A to E in the following reaction:



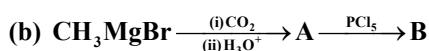
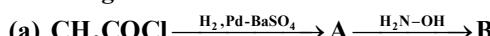
Delhi 2010C

30. Write the structures of A, B, C, D and E in the following reactions.

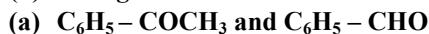


Delhi 2016

31. (i) Write the structures of A and B in the following reactions:



(ii) Distinguish between

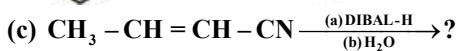
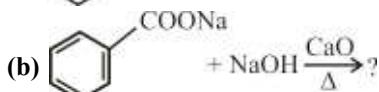
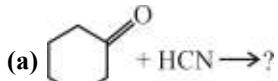


(iii) Arrange the following in increasing order of their boiling points.



All India 2016

32. (i) Write the products (s) in the following reactions



(ii) Give simple chemical tests to distinguish between the following pairs of compounds:

- (a) Butanal and butan-2-one
(b) Benzoic acid and phenol

All India 2017

33. (i) How will you prepare the following compounds starting with benzene?

- (a) Benzaldehyde (b) Acetophenone

(ii) How will you bring about the following conversions?

- (a) Propanone of propene
(b) Ethanol to 3-hydroxybutanal
(c) Benzaldehyde to benzophenone

Foreign 2010, 2009

34. (i) Describe:

- (a) Aldol condensation
(b) Cannizzaro reaction

(ii) Describe a chemical test to distinguish between

- (a) ethanal and propanal
(b) benzaldehyde and acetophenone
(c) propan-2-one and pentan-3-one

Foreign 2014

35. (i) An organic compound with molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1,2-benzenedicarboxylic acid. Identify the compound.

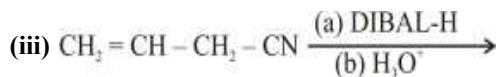
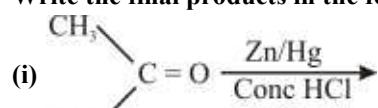
(ii) Give the chemical tests to distinguish between

- (a) propanol and propanone
(b) benzaldehyde and acetophenone

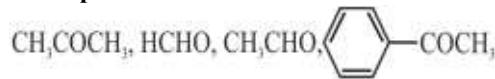
(iii) Arrange the following compounds in an increasing order of their property as indicated: Acetaldehyde, acetone, methyl tert-butyl ketone (reactivity towards HCN).

All India 2012

36. (a) Write the final products in the following :



- (b) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction :



- (c) Draw the structure of 2, 4 DNP derivative of acetaldehyde.

CBSE-2020

37. (a) Draw structures of the following derivatives :

- (i) Cyanohydrin of cyclobutanone

- (ii) Hemiacetal of ethanal

- (b) Write the major product(s) in the following :



CBSE-2020

38. (a) An organic compound 'A' having molecular formula $\text{C}_5\text{H}_{10}\text{O}$ gives negative Tollens' test, forms n-pentane on Clemmensen reduction but doesn't give iodoform test. Identify 'A' and give all the reactions involved.

- (b) Carry out the following conversions :

- (i) Propanoic acid to 2-Bromopropanoic acid

- (ii) Benzoyl chloride to benzaldehyde

- (b) How will you distinguish between benzaldehyde and acetaldehyde ?

CBSE-2020

39. (a) Give the mechanism for the formation of ethanol from ethane.

- (b) Predict the reagent for carrying out the following conversions:

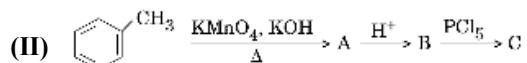
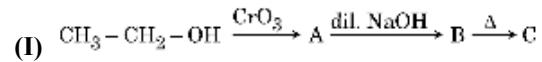
- (i) Phenol to benzoquinone

- (ii) Anisole to p-bromoanisole

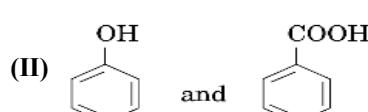
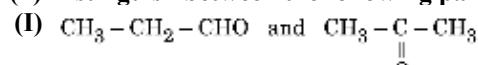
- (iii) Phenol to 2, 4, 6-tribromophenol

CBSE-2020

40. (a) (i) Identify A, B and C in the following reactions:

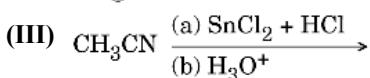
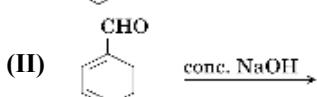
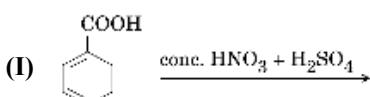


- (ii) Distinguish between the following pairs:



CBSE-2021

41. (i) Write the product (s) in the following reactions:

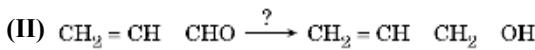
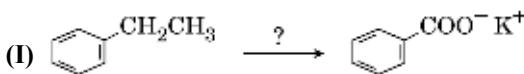


- (ii) Give reasons:

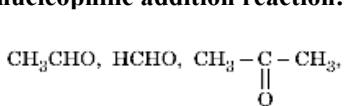
- (I) Carboxylic acids do not give the reactions of carbonyl group.
 (II) In semicarbazide ($\text{H}_2\text{NCONHNH}_2$), only one – NH_2 is involved in the formation of semicarbazones.

CBSE-2021

42. (i) Name the reagents used in the following reactions:



- (ii) Write the structure of oxime of propanal.
 (b) Why does carboxylic acid not give reactions of aldehydes and ketones?
 (c) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction:



CBSE-2021

43. Bring out the following conversions:

- (i) Benzene to m- dichlorobenzene
 (ii) Nitrobenzene to Benzamide
 (iii) Benzene to n-Butane

Odisha Board-2017

44. What are soap and detergents? How do they differ?

Odisha Board-2017

45. (a) How do you prepare benzoic acid from
 (i) n-propyl benzene, (ii) Phenylcyanide and
 (iii) Benzene?

Odisha Board-2017

46. Describe in brief the following:

- (a) Haber's process
 (b) Contact process
 (c) Ostwald's process
 (d) Interhalogen process
 (e) Anomalous behaviour of fluorine

Manipur Board-2017

47. Explain the following

- (i) Clemmensen reduction
 (ii) Aldol condensation

NIOS Board-2023

48. a) Give simple chemical test to distinguish between the following pairs of compounds:
 (i) Propanal and propanone
 (ii) Methanamine and N-Methyl methanamine

- b) How will you carry out the following conversions:

- (i) Benzene to aniline
 (ii) Ethyl chloride to propanoic acid

NIOS Board-2021

49. Illustrate the following reactions giving a chemical equation for each :

- (a) Kolbe's reaction

- (b) Hofmann's Bromamide reaction

NIOS Board-2021

50. Explain the following name reactions:

- (i) Hell-Volhard -Zelinsky reaction.
 (ii) Wolff-Kishner reduction.

Write chemical equations involved.

NIOS Board-2019

51. (a) How will you carry out the following conversions?

- (i) Benzaldehyde to Benzyl alcohol

- (ii) Methyl benzene to Benzoic acid

- (b) How will you distinguish among primary, secondary and tertiary alcohols?

- (c) Explain Kolbe reaction.

NIOS Board-2018

- 52.(a) How are the following conversions carried out?

- (i) Ethanol to chloroethane

- (ii) Benzene diazonium chloride to bromobenzene

- (iii) Chloromethane to propyne

- (iv) Chlorobenzene to 2-nitrochlorobenzene

- (b) Account for the following:

- (i) Haloalkanes are polar in nature, even then they are immiscible in water.

- (ii) Haloarenes are less reactive than haloalkanes towards nucleophilic substitution reaction

NIOS Board-2016

53. Explain the following (give chemical equation also)

- (a) Hoffmann bromamide reaction

- (b) Hell-Volhard-Zelinsky reaction

- (c) Wolff-Kishner reduction

NIOS Board-2016

54. How will you prepare? (Give chemical equation.)

- (a) Ethane from chloroethane

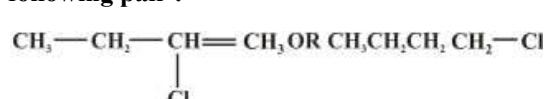
- (b) Toluene from chlorobenzene

- (c) Butane-1-ol from propyl magnesium bromide

- (d) 2,4,6-Tribromophenol from phenol

NIOS Board-2016

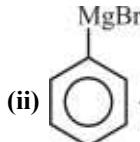
55. (a) (i) Identify the chiral molecule in the following pair :



- (ii) Which one of the following compound would show geometrical isomerism
 $\text{CH}_2 = \text{CBr}_2$ or $\text{CHBr} = \text{CHBr}$
(b) How are the following obtained :
(i) 2-Methyl-2-propanol from 2-methylpropene
(ii) Salicylic acid from phenol
(c) Write simple tests to distinguish between the following pairs of compounds :
(i) Propanal and propanone
(ii) Phenol and benzoic acid.

NIOS Board-2015

56. (a) Write the products of the following reactions :



- (b) Write the reaction sequence to convert nitromethane to ethanamine.
(c) What are lipids ? Name the three types of lipids. Give one example of each.

NIOS Board-2012

57. (a) Write chemical reactions to obtain the following:

- (i) Acetophenone from benzene
(ii) Benzoic acid from toluene

- (b) Giving one example of each, describe the following reactions:

- (i) Wurtz reaction
(ii) Hofmann bromamide reaction

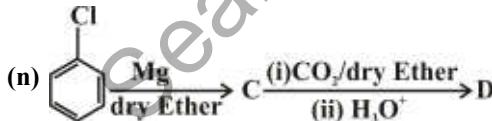
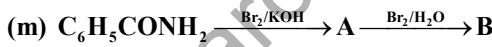
NIOS Board-2011

58. Describe the following :

- (i) Acetylation
(ii) Cannizaro reaction
(iii) Cross aldol condensation
(iv) Decarboxylation

Andhra Pradesh Board-2019

59. (i) Write structural formula of the compounds A to F.



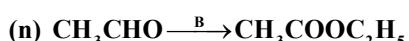
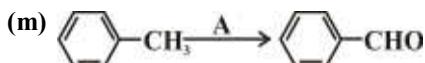
- (iii) Convert the following :

- (p) Benzaldehyde to Cinnamic acid.
(q) Acetic acid to acetaldehyde.

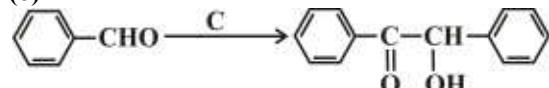
West Bengal Board-2019

60. (i) What is the reason for the reducing property of formic acid ? Give example of its reducing property.

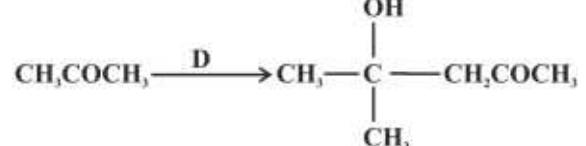
- (ii) Mention the reagents used for the following conversions :



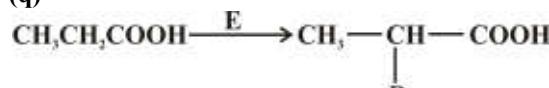
(o)



(p)



(q)



(r)



West Bengal Board-2019

61. What happens when-

- (i) Sandmeyer's reaction
(ii) Finkelstein reaction
(iii) Hundsdiecker reaction
(iv) Fitting reaction
(v) Ullmann reaction

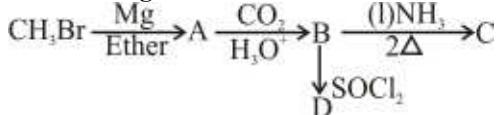
Punjab Board-2021

62. Write the following reactions :

- (i) Williamson synthesis
(ii) Mendius reaction
(iii) Friedel Craft's Alkylation
(iv) Haloform reaction.
(v) Carbylamine reaction
(vi) Gattermann reaction

Punjab Board-2017

63. (a) Write the structures of A, B, C and D in the following reactions :



- (b) Give simple chemical test to distinguish between :

- (i) Benzoic acid and phenol
(ii) Propanol and propane

NIOS Board-2022

64. a) How would you prepare acetaldehyde from acetyl chloride. Name the reaction.
b) Name the reagent used in the conversion of ketone to hydrocarbon. Name the reaction.
c) Acetaldehyde does not undergo Cannizzaro's reaction. Why ? (2 + 2 + 1)

Karnataka Board-2015

65. What happens when (write only chemical equation) ?

- (a) Carboxylic acid reacts with alcohol
(b) The reduction of acetaldehyde occurs in the presence of zinc amalgam/HCl
(c) Toluene reacts with chromyl chloride in the presence of CS_2 .
(d) Acetic acid reacts with Na metal
(e) NaOH and I_2 react with acetone

Chhattisgarh Board-2022

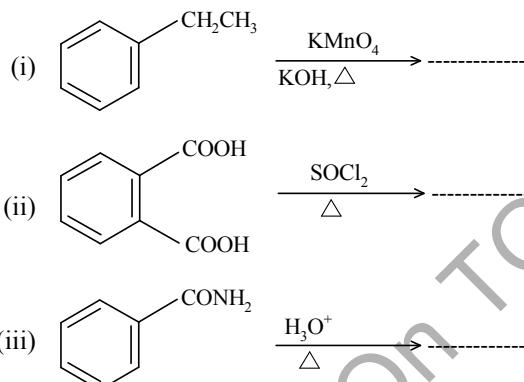
66. Explain the following reactions (write only chemical equations)
- Acetylation
 - Decarboxylation
 - Friedel-Crafts reaction
 - Schmidt reaction
 - Clemmensen reduction

Chhattisgarh Board-2021

67. How will you bring about the following conversions in not more than 2 steps?
- Propanone to propene
 - Benzaldehyde to benzophenone
 - Ethanol to 3-hydroxybutanal
 - Benzoic acid to benzaldehyde
 - Bromobenzene to 1-phenylethanol

Chhattisgarh Board-2021

- 68.
- What happens when Calcium Ethanoate is distilled?
 - Explain, why Acetaldehyde gives Aldol condensation while formaldehyde does not.
 - Complete the following reactions—

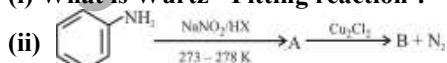


Uttarakhand Board-2019

- 69.
- Among the following which one is chlorine containing insecticide?
 - DDT
 - Freon
 - Phosgene
 - Iodoform

- (b) Halo arenes undergo Wurtz-Fitting reaction.

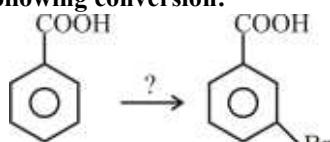
- (i) What is Wurtz - Fitting reaction ?



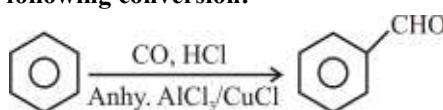
Write the formula of A and B in the above reaction.

Kerala Board-2015

70. Do as directed:
- Write the reagent used to bring about the following conversion:



- Write labelled chemical equation to show, what happens when Benzoyl chloride is hydrogenated in the presence of palladium and barium sulphate.
- Arrange the following compounds in the increasing order of their acidic strength: CCl_3COOH , $\text{NC}-\text{CH}_2\text{COOH}$, CF_3COOH , $\text{NO}_2\text{CH}_2\text{COOH}$.
- State the name of the reaction in the following conversion:



Goa Board-2019

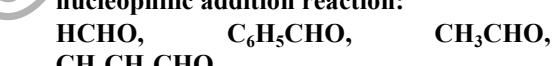
71. Do as directed:

- (a) Write the reagent used to bring about the following conversion:

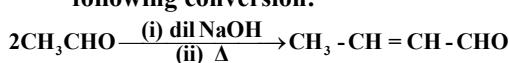


- (b) Write labelled chemical equation to show, what happens when Benzene is treated with acetylchloride in the presence of anhydrous AlCl_3

- (c) Arrange the following compounds in the increasing order of their reactivity towards nucleophilic addition reaction:



- (d) State the name of the reaction in the following conversion:



Goa Board-2019

- 72.
- Write a test to distinguish between aldehydes and ketones.
 - How will you prepare benzaldehyde by Etard's reaction?
 - How will you bring about the following conversions? (Write the chemical equations)
- Ethanol \rightarrow Ethanoic acid
 - Benzamide \rightarrow Benzoic acid
 - Benzaldehyde \rightarrow Meta nitro benzaldehyde

Kerala Board-2016

- 73.
- Why are the boiling points of carboxylic acid higher than those of the corresponding alcohols?
 - Define the following terms and write the reaction involved in it :
- Reimer-Tiemann reaction
 - Rosenmund's reduction reaction.

Nagaland Board-2018

13.

Organic Compounds Containing Nitrogen

A. Structure and Identification of Amines

Section-A : Multiple Choice Questions

1. Which of the following reagents is used for the Hinsberg test of amines?
(a) C_6H_5COCl
(b) CH_3COCl
(c) $C_6H_5-SO_3H$
(d) $C_6H_5-SO_2Cl$

CBSE-2021

Ans. (d)

2. Which of the following is a secondary amine?
(a) Aniline
(b) Diphenylamine
(c) Secondary butyl amine
(d) Tertiary butyl amine

Tamil Nadu Board-2016

Ans. (b)

3. Acid anhydride on reaction with primary amine gives compound having a functional group _____.
(a) Amide
(b) Nitrile
(c) Secondary amine
(d) Imine

Maharashtra board-2022

Ans. (a)

4. Which of the following is a 3° amine?
(a) Triethylamine (b) t-Butylamine
(c) N-methylamine (d) Ethylamine

Haryana Board-2017

Ans. (a)

5. Gabriel Pthalimide Synthesis is used for preparation of— [1]
(a) 1° amine (b) 2° amine
(c) 3° amine (d) All of these

Uttarakhand Board-2019
Meghalaya Board-2018

Ans. (a)

6. In which reaction 1° amine is not obtain?
(a) Reduction of isonitrile
(b) Reduction of nitrile
(c) Hoffmann reaction of amide
(d) Reduction of amide

Gujarat Board-2018

Ans. (a)

7. Amines are:
(a) Acidic (b) Basic
(c) Neutral (d) None of these

J & K board-2023

Ans. (b)

8. Trimethylamine, $(CH_3)_3N$ is a
(a) 1° amine
(b) 2° amine
(c) 3° amine
(d) 4° amine

Meghalaya Board-2021

Ans. (c)

9. Which of the following is functional group of primary amine?
(a) $-NH$
(b) $-NH_2$
(c) $-NH_3^+$
(d) $-NH_4^+$

Jharkhand Board-2023

Ans. (b)

10. Which of the following compounds gives dye test?
(a) Aniline
(b) Methylamine
(c) Diphenylamine
(d) Ethylamine

Meghalaya Board-2018

Ans. (a)

Section-B : Very Short Answer

1. Give IUPAC name of the following compounds.
(i) $CH_3 - CH - N - CH_3$
 $\quad \quad \quad | \quad |$
 $\quad \quad \quad CH_3 \quad CH_3$
(ii) $CH_3 - CH_2 - NHCOCH_3$

Gujarat Board-2022 (July)

2. Arrange the following in increasing order of PK_b values:
 $C_6H_5CH_2NH_2, C_6H_5NHCH_3, C_6H_5NH_2$

CBSE-2019

3. How can primary, secondary and tertiary aliphatic amines be distinguished by reaction with HNO_2 ?
($NaNO_2 + dil. H_2SO_4$)?

ISC Board-2005

4. Identify A, b and C



ISC Board-2005

5. How will you distinguish between primary, secondary and tertiary amines by Hinsberg's test?

ISC Board-2017

6. Draw the structure of prop-2-en-1-amine.

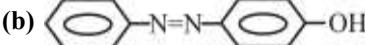
All India 2013

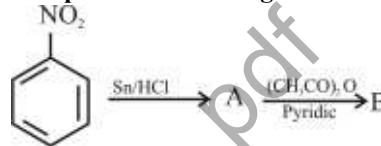
7. Draw the structure of N-methylethanamine.

All India 2013

8. Draw the structure of 2-aminotoluene.

All India 2013

9. On heating ethylamine with CHCl_3 and KOH _____ is formed.
Chhattisgarh Board-2023
10. Among $(\text{C}_2\text{H}_5)_2\text{NH}$ and $\text{C}_2\text{H}_5\text{NH}_2$, is more basic.
Haryana Board-2022
11. Write chemical reaction for the preparation of glucose from sucrose. Write structure of D-ribose.
Maharashtra board-2023
12. What is the action of the following reagents on ethyl amine
 (i) Chloroform and caustic potash
 (ii) Nitrous acid
Maharashtra board-2023
13. Name the test used to identify primary amines using CHCl_3 and ethanolic KOH.
Kerala Board-2018
14. Write IUPAC name of the compound $(\text{CH}_3\text{CH}_2)_2\text{NCH}_3$.
Haryana Board-2018
15. Write the name of following compounds:
 (a) $\text{C}_6\text{H}_5\text{N}_2^{\oplus}\text{HSO}_4^{\ominus}$
 (b) 
Rajasthan Board-2017
16. Write IUPAC name of
 $\begin{array}{c} \text{C}_2\text{H}_5 - \text{N} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3. \\ | \\ \text{C}_2\text{H}_5 \end{array}$
Rajasthan Board-2015
17. Give one reaction that can be used as a test for primary amines.
Meghalaya Board-2019
18. What happens when
 (i) Primary amines reacts with nitrous acid.
 (ii) Aromatic amines reacts with nitrous acid.
Nagaland Board-2021
19. Why is secondary amine more basic than the tertiary amine?
Nagaland Board-2018
20. How can 1° , 2° and 3° amine be distinguished by Hinsberg test?
Nagaland Board-2018
21. What are amines?
Nagaland Board-2018
22. Why are aliphatic amines stronger base than the aromatic amines ?
Nagaland Board-2017
23. (a) What is carbylaminies reaction? Give the reaction
Nagaland Board-2017
24. Give one test to distinguish primary, secondary and tertiary amines from each other.
Nagaland Board-2017
25. Primary amines have higher boiling points than tertiary amines. Why?
Meghalaya Board-2018

- Section-C : Short Answer**
1. Draw pyramidal shape of trimethylamine.
Rajasthan Board 2022
2. Identify primary, Secondary and Tertiary amine in following compounds-
 (a) $\begin{array}{c} \text{CH}_3\text{H}_5 - \text{N} - \text{CH}_2\text{CH}_3 \\ | \\ \text{C}_2\text{H}_5 \end{array}$
 (b) $\text{CH}_3\text{NHCH}_2\text{CH}_3$
 (c) $\text{CH}_3\text{CH}_2\text{NH}_2$
Uttarakhand Board 2022
3. (a) Which of the following is a secondary amine ?
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2, \text{CH}_3\text{CH}_2\text{NHCH}_2\text{CH}_3, \text{CH}_3 - \begin{array}{c} \text{N} \\ | \\ \text{C}_2\text{H}_5 \\ | \\ \text{CH}_3 \end{array}$
 (b) Complete the following :

CBSE-2022
4. (a) Give one chemical test to distinguish between the compounds of the following pairs :
 (i) CH_3NH_2 and $(\text{CH}_3)_2\text{NH}$
 (ii) Aniline and Ethanamine
 (b) Why aniline does not undergo Friedel-Crafts reaction ?
CBSE-2019
5. What is meant by canonical structures? Draw canonical structures and hybrid structures of nitromethane and benzene.
NIOS Board-2018
6. Arrange the following compounds in decreasing order of basic strength in aqueous solution :
 $\text{C}_2\text{H}_5\text{NH}_2, (\text{C}_2\text{H}_5)_2\text{NH}, (\text{C}_2\text{H}_5)_3\text{N}, \text{NH}_3$
Goa Board-2019
7. Classify each of the following as being either a p-type or n-type semiconductor
 (a) Ge doped with B
 (b) Si doped with As
Kerala Board-2020
8. Amines are classified as primary, secondary and tertiary.
 (a) Write the IUPAC name of the following compound $\text{NH}_2 - (\text{CH}_2)_6 - \text{NH}_2$
 (b) Which is stronger base – CH_3NH_2 or $\text{C}_6\text{H}_5\text{NH}_2$? Why?
Kerala Board-2015
9. What are Amines? How are they classified? Give one example of each type.
 Or
 How is aniline prepared from (i) Nitrobenzene
 (ii) Benzamide (iii) Phenyl cyanide?
J & K Board-2021

10. (a) Arrange the following substances in increasing order of their basic strength in water:



(b) Out of ethylamine and ethyl alcohol, which has higher boiling point and why?

Meghalaya Board-2019

11. (a) Account for the following:

- (i) Ethylamine is soluble in water whereas aniline is not;
- (ii) pK_b of aniline is more than that of methylamine;
- (iii) Aniline does not undergo Friedel-Crafts reaction.

Meghalaya Board-2021

12. (b) Arrange the following in decreasing order of their basic strength:



(c) Give equation only for the preparation of primary amines by Hofmann bromamide degradation reaction.

(d) What happens on reduction of nitriles ($\text{R}-\text{C}\equiv\text{N}$) with LiAlH_4 ? (Give equation only)

Meghalaya Board-2021

Section-E : Long Answer

1. Amines are classified as primary, secondary and tertiary amine.

(a) Represent the structure of secondary and tertiary amine.

(b) How will you convert nitrobenzene to aniline ?

(c) Aniline does not undergo Friedel -Crafts reaction. Why?

Kerala Board-2016

2. What are primary, secondary and tertiary amines ? Give one example of each.

Or

Explain why aromatic amines are less basic than ammonia and aliphatic amines.

J&K Board-2020

B. Nomenclature

Section-A : Multiple Choice Questions

1. Which type of isomerism is present in iso propyl amine and n-propyl amine?

- (a) Function
- (b) Chain
- (c) Position
- (d) Tautomerism

Gujarat Board-2021

Ans. (c)

2. Number of sigma and pi bonds in acetanilide is

- (a) 19,4
- (b) 16, 4
- (c) 20,3
- (d) 19,3

Gujarat Board-2017

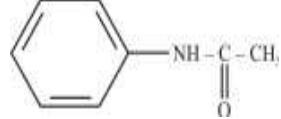
Ans. (a)

Section-B : Very Short Answer

1. Write the type of hybridisation of orbitals for nitrogen present in amine.

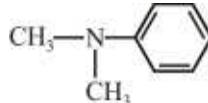
Rajasthan Board 2022

2. Write the IUPAC name of



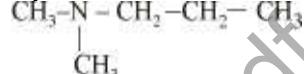
CBSE-2020

3. Write the IUPAC name of



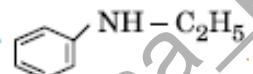
CBSE-2020

4. Write the IUPAC name of the following compound :



CBSE-2019
name of

5. Write the IUPAC

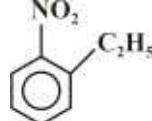


CBSE-2019

6. Give IUPAC name of $\text{H}_2\text{N}-\text{CH}_2-\text{CH}_2-\text{CH}=\text{CH}_2$

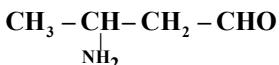
Delhi 2010

7. Write IUPAC name of the following:



Delhi 2013C

8. Write the IUPAC name of the compound



All India 2014

9. Write IUPAC name of the following compound:

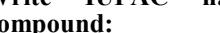


10. Write IUPAC name of the following compound:



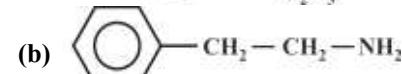
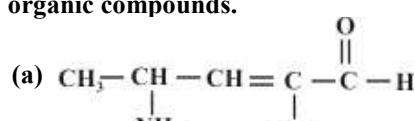
Delhi 2017

11. Write IUPAC name of the following compound:



Delhi 2017

12. Write the IUPAC name of the following organic compounds.



Manipur Board-2018

7. $\text{CH}_3\text{Cl} \xrightarrow{\text{KCN}} \text{A} \xrightarrow{\text{Na/C}_2\text{H}_5\text{OH}} \text{P, P is.}$
 (a) $\text{CH}_3\text{CH}_2\text{Cl}$ (b) $\text{CH}_3\text{CH}_2\text{NH}_2$
 (c) $\text{C}_2\text{H}_5\text{CN}$ (d) C_3H_8

Haryana Board-2022

Ans. (b)

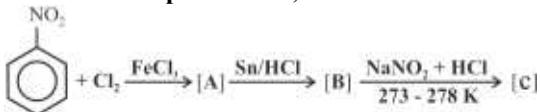
8. Williamson Synthesis is used to prepare :

- (a) Alcohol
 (b) Amine
 (c) Ketone
 (d) Ether

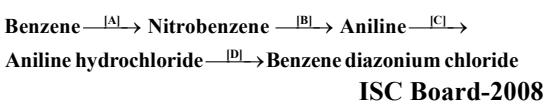
Haryana Board-2021

Ans. (d)

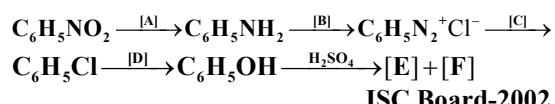
Section-B : Very Short Answer

- (i) Write short note on coupling reaction.
 (ii) Why Gabriel phthalimide synthesis is preferred for synthesizing primary amines?
 Haryana Board 2023
- Ethyl amine is soluble in water but Aniline does not.
 Haryana Board 2023
- Explain following :
 (a) Carbylamine reaction.
 Kerala Board 2023
 MP Board 2020
- (a) Explain Carbylamine reaction with equation.
 (b) How is aniline prepared from nitrobenzene?
 (c) Give the IUPAC name of trimethylamine.
 Karnataka board 2023
- What type of carboxylic acids undergo Hell-Volhard-Zelinsky (HVZ) reaction. Explain this reaction with example.
 Karnataka board 2023
- Complete the equation.
 $\text{HNO}_2 \xrightarrow{\text{NaNO}_2, \text{HCl}} [\text{H}_3\text{CN}'\text{Cl}] \xrightarrow{\text{H}_2\text{O}} \text{CH}_3\text{OH} \quad \text{HCl}$
 Karnataka board 2023
- Write short note on Hoffmann bromamide degradation reaction.
 Rajasthan Board 2023
- Write an isomer of $\text{C}_3\text{H}_9\text{N}$ which does not react with Hinsberg reagent.
 CBSE-2020
- Give balanced equation for the following reaction given below:
 Aniline is treated with a mixture of NaNO_2 and excess of HCl at low temperature.
 ISC Board-2007
- complete the following reaction and name the intermediate products A, B and C:

 ISC Board-2006

11. State the reagents for the following conversion:



12. Identify the compounds A, B, C, D, E and F required for the following conversion:

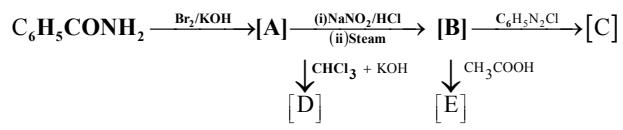


ISC Board-2002

13. How will you carry out the following conversion ?
 Aniline to chlorobenzene

ISC Board-2002

14. Identify A, B, C, D and E



ISC Board-2003

15. Identify A, B, C, D and E,
 Benzoic acid $\xrightarrow{\text{NH}_3, \text{Heat}}$ $[\text{A}] \xrightarrow{\text{Br}_2/\text{KOH}} [\text{B}]$
 $\xrightarrow{\substack{\text{NaNO}_2 + \text{HCl} \\ \text{Ice cold}}} [\text{C}] \xrightarrow{\substack{\text{CuCl} \\ \text{HCl}}} [\text{D}] \xrightarrow{\substack{\text{Sn/HCl}}} [\text{E}]$

ISC Board-2001

16. How can the following conversion be brought about?
 Acetic acid to methyl cyanide.

ISC Board-2014

17. Give the structures of various amines with molecular formula $\text{C}_3\text{H}_9\text{N}$. State whether they are primary, secondary or tertiary. Amines?

ISC Board-2002

18. Write the balanced equations of the following reactions:

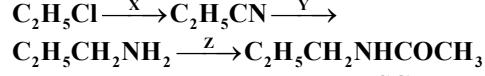
- (a) Aniline and bromine water
 (b) Ethylamine and nitrous acid
 (c) Acetic anhydride and ammonia

ISC Board-2008

19. Acetamide is amphoteric in nature. Give two equations to support this statement.

ISC Board-2013

20. Identify the reagents, X, Y and Z



ISC Board-2012

21. Give one good chemical test to distinguish between the following pair of organic compounds:

Methyl amine and dimethyl amine

ISC Board-2011

22. How will you distinguish between the following pair of compounds?

Give one chemical test.

Ethylamine and acetamide.

ISC Board-2009

23. Give reason.

Direct nitration of aniline is not possible.

ISC Board-2007

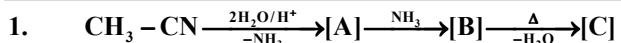
24. How will you carry out the following conversion?

Acetamide to ethylamine.

ISC Board-2003

25. Give two test to distinguish between aniline and dimethyl aniline.
ISC Board-2003
26. How will you carry out the following conversion? Write the balanced equation and name the reaction.
Acetamide to methylamine
ISC Board-2000, 2001
27. How can the following conversions be brought about:
(a) Acetic acid to methylamine.
(b) Aniline to benzene.
ISC Board-2017
28. An organic compound A with molecular formula C_2H_7N on reaction with nitrous acid gives a compound B. B on controlled oxidation gives compound C. C reduces Tollen's reagent to give silver mirror and D. B reacts wth D in the presence of concentrated sulphuric acid to give sweet smelling compound E. Identify A, B, C, D and E. Give the reaction of C with ammonia.
ISC Board-2015
29. How can the following conversion be brought about?
Ethylamine to methylamine
ISC Board-2000, 2010
30. How can the following conversion be brought about?
Benzene to acetanilide
ISC Board-2010
31. Basicity of aniline is than that of ammonia because of
ISC Board-2009
32. Give the balanced equations for following reactions:
(a) Ethylamine with nitrous acid
(b) Aniline with acetyl chloride.
ISC Board-2016
33. Arrange the following compounds in the ascending order of their basic strength and give reasons for your answer:
Methylamine, Aniline, Ethylamine, Diethyl ether
ISC Board-2015
34. Give the balanced equations for following reactions:
(a) How will you convert ethylamine to methylamine?
(b) Aniline is treated with nitrous acid and HCl at low temperature.
ISC Board-2016
35. Give the chemical test to distinguish between the following pair of compounds:
Aniline and ethylamine.
ISC Board-2014
36. Give one example of the following name reaction:
Hoffmann's degradation
ISC Board-2009
37. Explain the following with at least one example:
Carbylamine reaction
ISC Board-2007
38. How would you convert the following? Methylamine to ethylamine
ISC Board-2007
39. Write the balanced chemical equation for the following and name the reaction:
Aniline is warmed with chloroform and alcoholic potassium hydroxide.
ISC Board-2002, 2006
40. How will you convert the acetic anhydride to methylamine?
ISC Board-2004
41. Methylamine is more than ammonia because of effect.
ISC Board-2002
42. Give the balanced equation for Hoffmann's degradation reaction.
ISC Board-2015
43. Give a chemical test to distinguish between ethylamine and diethylamine.
ISC Board-2014
44. Write the equation for the preparation of acetanilide from aniline
ISC Board-2014
45. Write the balanced chemical equation for the following reaction and name the reaction:
Acetamide is heated with bromine and sodium hydroxide solution.
ISC Board-2013
46. Convert benzoic acid to aniline.
ISC Board-2016
47. Give a chemical test to distinguish between each of the following pairs of compounds:
(i) Ethylamine and aniline.
(ii) Aniline and benzylamine.
All India 2014C
48. Give chemical tests to distinguish between the following pairs of compounds:
(i) Aniline and ethylamine.
(ii) Ethylamine and dimethylamine.
Delhi 2013C
49. Write one reaction that can be used as a test for primary amines.
Foreign 2011
50. Give a chemical test to distinguish between ethylamine and aniline.
All India 2011, 2010, 2009C
51. Primary, secondary and Tertiary amines differentiated by
Haryana Board-2022
52. How is methyl amine prepared from Hoffmann's Bromide reaction? Give its reaction with Grignard's reagent.
J&K Board-2019
53. Explain carbylamines with equation.
Chhattisgarh Board-2022
54. Explain carbylamine reaction with equation.
Kerala Board-2022
55. Predict the product of the following reaction:
 $C_2H_5NO_2 \xrightarrow{Sn/HCl} \dots$
J & K Board-2021
56. Write Gabriel-phthalimide synthesis with the reaction involved in it.
Nagaland Board-2021

Section-C : Short Answer



Write chemical formula of [A], [B] and [C] in above reaction sequence.

Rajasthan Board 2022

2. Show how would you convert benzenediazonium chloride to benzylamine
Manipur Board 2023

3. Benzamide undergoes acidic hydrolysis.

UP Board 2023

4. Gattermann-Koch reaction

UP Board 2023

5. A primary amine 'A' $\text{C}_2\text{H}_7\text{N}$ reacts with alkyl halide ($\text{C}_2\text{H}_5\text{I}$) to give secondary amine 'B'. 'B' reacts with $\text{C}_6\text{H}_5\text{SO}_2\text{Cl}$ to give a solid 'C' which is insoluble in alkali. Identify 'A', 'B', 'C' and write all the chemical reactions involved.

CBSE-2022

6. Give any one conversion from the following.
(a) Acetanilide from chlorobenzene
(b) Phenol from aniline.

Gujarat Board-2016

7. (iii) Draw the structures of chloroxylenol and adenine.
(iv) How are ethylamine and ethylmethylamine distinguished by using nitrous acid ?

Maharashtra board-2018

8. Write the equations for the following preparations:

- (a) Ethyl alcohol from primary amine.

Rajasthan Board-2010

9. Write the required condition to maximize the yield of ammonia by Haber's process. What happens when NH_3 reacts with (a) Cu^{2+} and (b) Cl_2 ?

Jharkhand Board-2023

Section-D : Case Based Study

1. Write a short note on Gabriel's phthalimide synthesis. Why is Gabriel's phthalimide synthesis preferred for synthesizing the primary amines ?

UP Board 2023

Section-E : Long Answer

1. Describe Hoffmann's bromamide degradation reaction.

Gujarat Board-2021

2. Explain the laboratory method for the preparation of ethylamine on the following points.
(i) Theory
(ii) Chemical reaction
(iii) Labelled diagram

Chhattisgarh Board-2023

3. Explain the laboratory method of preparation of aniline on the following points.
(i) Theory
(ii) Chemical reaction
(iii) Labelled diagram

Chhattisgarh Board-2023

4. Explain Ostwald process of manufacture of nitric acid under the following points :

- (i) Theory and equations.
(ii) Labelled diagram.

Chhattisgarh Board-2023

5. Complete the following table:

Sl. No.	Reactant	Reagent	Product	Name of Reaction
1.	$\text{CH}_3\text{CH}_2\text{NH}_2$	$\text{CHCl}_3/\text{KOH}_{\text{alc}}$		Carbylamine reaction
2.	CH_3CONH_2	Br_2/NaOH	CH_3NH_2
3.	$\text{NaNO}_2 + \text{HCl}/273\text{K}$	$\text{C}_6\text{H}_5\text{N}^+ \text{Cl}^-$	Diazotisation

Kerala Board-2020

6. Answer the following questions :

Convert the following :

- (i) Ethyl amine to Ethyl isocyanide
(ii) Aniline to p-Nitroaniline
(iii) Acetamide to Methyl amine

Assam Board-2023

D. Physical and Chemical Properties of Amines

Section-A : Multiple Choice Questions

1. Which compound will not give ethanamine on reduction?
(a) Nitroethane (b) Ethanamide
(c) Ethanol chloride (d) Ethanenitrile

Gujarat Board 2023 (March)

Ans. (d) :

2. For following compounds which is true decreasing order for pK_b value?
(a) $\text{C}_2\text{H}_5\text{NH}_2 > \text{C}_6\text{H}_5\text{NHCH}_3 > (\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_6\text{H}_5\text{NH}_2$
(b) $\text{C}_2\text{H}_5\text{NH}_2 > \text{C}_6\text{H}_5\text{NH}_2 > \text{C}_6\text{H}_5\text{NHCH}_3 > (\text{C}_2\text{H}_5)_2\text{NH}$
(c) $\text{C}_6\text{H}_5\text{NHCH}_3 > (\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_6\text{H}_5\text{NH}_2 > \text{C}_2\text{H}_5\text{NH}_2$
(d) $\text{C}_6\text{H}_5\text{NH}_2 > \text{C}_6\text{H}_5\text{NHCH}_3 > \text{C}_2\text{H}_5\text{NH}_2 > (\text{C}_2\text{H}_5)_2\text{NH}$

Gujarat Board-2022 (July)

Ans. (d)

3. Which of the following is tertiary amine?
(a) $(\text{C}_2\text{H}_5)_4\text{N}^+$ (b) $(\text{C}_2\text{H}_5)_3\text{N}$
(c) $(\text{C}_2\text{H}_5)_2\text{NH}$ (d) $(\text{C}_2\text{H}_5)_2\text{CHNH}_2$

Gujarat Board-2022 (July)

Ans. (b)

4. The amine having lowest pK_b value is
(a) CH_3NH_2 (b) $(\text{CH}_3)_2\text{NH}$
(c) $(\text{CH}_3)_3\text{N}$ (d) $\text{C}_6\text{H}_5\text{NH}_2$

Rajasthan Board-2022

Ans. (b)

5. Hinsberg's reagent is –
(a) Benzene sulphonic acid
(b) Benzene sulphonyl chloride
(c) Benzene sulphonamide
(d) Phenyl isocyanide

UP Board 2023

Ans. (b)

Section-B : Very Short Answer

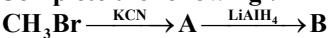
1. Write the increasing of strongest basicity of the following:
 $\text{C}_2\text{H}_5\text{NH}_2$, $\text{C}_6\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$ and $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$
Haryana Board-2018
2. How is benzene diazonium chloride obtained from aniline? Write equation and also write its two uses.
UP Board 2019
3. Give conversion (three steps) Aniline into 4-Bromo aniline.
Gujarat Board-2022 (July)
4. Ethyl amine is soluble in water while aniline is not.
MP Board 2020
5. Write balanced chemical equation of the reaction of ethanamine with the following :
 - $\text{NaNO}_2 + \text{dil. HCl}$
 - Hinsberg reagentUP Board 2023
6. Write short notes on the following :
 - Reaction of NaNO_3 and H_2SO_4
 - Reaction of conc. HNO_3 with I_2
 - Reaction of nitric acid and zincUP Board 2023
7. Explain why aniline is less basic than ammonia.
Kerala Board 2023
8. Aniline does not undergo Friedel Craft's reaction. Why?
Kerala Board 2023
9. A saturated monoamine liberates nitrogen gas on reaction with nitrous acid in cold condition. On heating with methyl iodide it forms quartemary ammonium iodide (mol. mass = 215). Deduce the formula of the amine. (Given at mass of iodine = 127)
Manipur Board 2020
10. Explain the isocyanide test for primary amines.
Rajasthan Board 2022
11. Describe any one method for the identification of primary, secondary and tertiary amines. Write the chemical equations also for the reactions involved
Uttarakhand Board 2023
12. Out of $(\text{CH}_3)_3\text{N}$ and $(\text{CH}_3)_2\text{NH}$, which one is more basic in aqueous solution?
CBSE-2020
13. Out of CH_3NH_2 and CH_3OH , which has higher boiling point?
CBSE-2020
14. (a) Choose the tertiary amine from the following compounds:

$$\text{CH}_3\text{NH}-\underset{\substack{| \\ \text{CH}_3}}{\text{CH}}-\text{CH}_3, \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2, \underset{\substack{| \\ \text{CH}_3}}{\text{CH}_3}-\text{N}-\text{C}_2\text{H}_5$$

 (b) Complete the following :

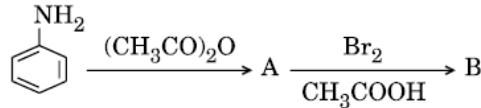
$$\text{CH}_3\text{COOH} \xrightarrow[\Delta]{\text{NH}_3} \text{A} \xrightarrow{\text{NaOH} + \text{Br}_2} \text{B}$$
CBSE-2022
15. (a) Choose the primary amine from the following compounds :
 $(\text{C}_2\text{H}_5)_2\text{CHNH}_2, (\text{C}_2\text{H}_5)_2\text{NH}, (\text{CH}_3)_3\text{N}$

(b) Complete the following :



CBSE-2022

16. (a) Identify 'A' and 'B' in the following reaction:

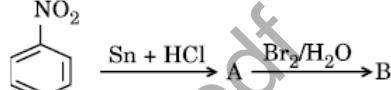


(b) Why does aniline not undergo Friedel-Crafts reaction?
CBSE-2019

17. Arrange the following in decreasing order of solubility in water :
 $(\text{CH}_3)_3\text{N}, (\text{CH}_3)_2\text{NH}, \text{CH}_3\text{NH}_2$

CBSE-2019

18. (a) Identify 'A' and 'B' in the following reaction:

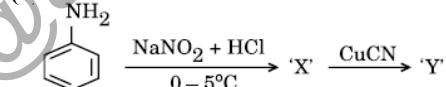


(b) Why is ethylamine soluble in water whereas aniline is not ?
CBSE-2019

19. Arrange the following in increasing order of boiling points :
 $(\text{CH}_3)_3\text{N}, \text{C}_2\text{H}_5\text{OH}, \text{C}_2\text{H}_5\text{NH}_2$

CBSE-2019

20. (a) Identify X and Y in the following :

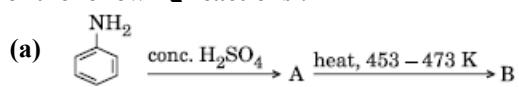


(b) Amino group is o, p-directing for aromatic electrophilic substitution reactions. Why does aniline on nitration give m-nitroaniline ?
CBSE-2019

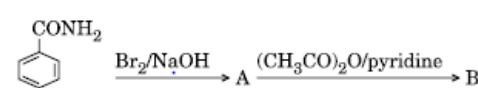
21. Account for the following :

(a) Gabriel phthalimide synthesis is not preferred for preparing aromatic primary amines.
 (b) On reaction with benzene sulphonyl chloride, primary amine yields product soluble in alkali whereas secondary amine yields product insoluble in alkali.
CBSE-2019

22. Write structures of compounds A and B in each of the following reactions :



(b)

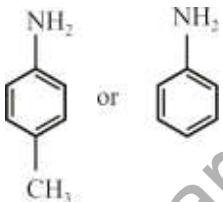
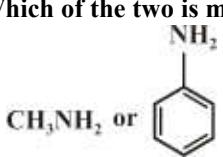


CBSE-2019

23. Give the balanced equation for the following reaction:

Aniline is treated with benzoyl chloride.

ISC Board-2009

24. Give the balanced equation for carbylamine reaction. ISC Board-2016
25. Assign reason for
 (i) Amines are less acidic than alcohols of comparable molecular masses.
 (ii) Aliphatic amines are stronger bases than aromatic amines. All India 2009C
26. Arrange the following compounds in a decreasing order of basic strength in their aqueous solutions:
 NH_3 , CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$ Delhi 2012; All India 2009; foreign 2009
27. Rearrange the following in an increasing order of their basic strength.
 $\text{C}_6\text{H}_5\text{NH}_2$, $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$ and CH_3NH_2 . All India 2011; Foreign 2009
28. Arrange the following in increasing order of basic strength:
 $\text{C}_6\text{H}_5\text{NH}_2$, $\text{C}_6\text{H}_5\text{NHCH}_3$, $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$ All India 2014
29. Why does NH_3 act as a Lewis base? Delhi 2014
30. Arrange the following in increasing order of their basic strength in aqueous solution:
 CH_3NH_2 , $(\text{CH}_3)_3\text{N}$, $(\text{CH}_3)_2\text{NH}$ Delhi 2013
31. Arrange the following in increasing order of basic strength: aniline, P-nitroaniline and p-toluidine. All India 2015C; Foreign 2008
32. Arrange the following compounds in an increasing order of their solubility in water.
 $\text{C}_6\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$, $\text{C}_2\text{H}_5\text{NH}_2$ All India 2014, 2011, 2008; Delhi 2011
33. Which of the two is more basic and why?

Foreign 2014
34. Which of the two is more basic and why?
 CH_3NH_2 or NH_3 Foreign 2014
35. Which of the two is more basic and why?

Foreign 2014
36. Out of $\text{CH}_3\text{—NH}_2$ and $(\text{CH}_3)_3\text{N}$, which one has higher boiling point? Delhi 2014C
37. pK_b of aniline is more than of methylamine. Why? Assam Board-2022
38. Arrange the following in decreasing order of their basic strength-
 NH_3 , $\text{C}_2\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$, $\text{C}_6\text{H}_5\text{NH}_2$ Uttarakhand Board-2020
39. How does methylamine reacts with carbonyl chloride? What is the name of the insecticide prepared by using this product? Manipur Board-2018
40. Why aliphatic amines are stronger bases than ammonia ? Punjab Board-2019
41. Why do amines act as nucleophiles ? Punjab Board-2019
42. How can you stop the formation of secondary and tertiary amine during the preparation of amine by alkylation of ammonia ? Chhattisgarh Board-2022
43. Write the following in increasing order of boiling point :
 $\text{C}_2\text{H}_5\text{OH}$, $(\text{CH}_3)_2\text{NH}$, $\text{C}_2\text{H}_5\text{NH}_2$ Chhattisgarh Board-2022
44. How is a primary amine distinguished from a secondary amine using a chemical test? Kerala Board-2019
45. $\text{CH}_3\text{—NH}_2$ is more basic than NH_3 while $\text{C}_6\text{H}_5\text{—NH}_2$ is less basic than NH_3 . Explain. Kerala Board-2022
46. (a) Give a chemical test for primary amines.
 (b) What happens when aniline reacts with bromine water at room temperature?
 (c) Write the diazotization reaction of aniline. Assam Board-2018
47. Answer the following:
 (a) Arrange in increasing order of basic strength:
 CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$
(in aqueous solution)
- (b) K_b value of aniline is less than that of methyl amine. Why? Assam Board-2015
48. Methyl amine is basic than ammonia. MP Board-2015
49. Fill in the blanks:
 (v) On heating alkyl isocyanide to 250°C is formed. MP Board-2014
50. Why does aniline turn blackish brown in open air? MP Board-2013
51. Fill in the blanks:
 (b) The basic character of Amine is due to the presence of on Nitrogen atom. MP Board-2013

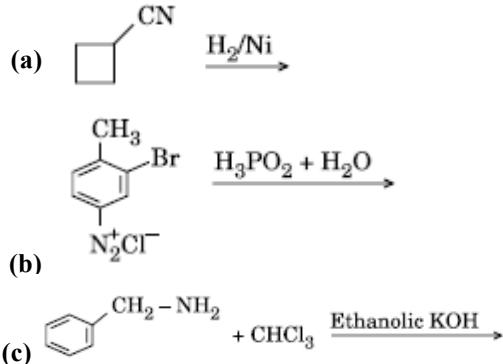
Section-C : Short Answer

1. What happens when : (Write equations only)
- Ethyl amine react with Nitrous acid.
 - Aniline reacts with bromine water in aqueous medium.
 - Aniline reacts with sodium Nitrite and hydrochloric acid at 278 K.
- MP Board 2020
2. An amine with molecular formula C_3H_9N reacts with $NaNO_2/HCl$ to form a carcinogenic nitrosamine derivate. Write the structure of the amine.
- Manipur Board 2023
3. Give reason that trimethyl amine is less basic than methyl amine.
- Rajasthan Board 2023
4. Complete the following reactions-
- $C_2H_5NH_2 + CH_2COCl \xrightarrow{\text{Pyridine}}$
 - $C_2H_5NH_2 + HNO_2 \xrightarrow{\text{NaNO}_2 + HCl}$
 - $C_6H_5NH_2 + 3Br_2 \xrightarrow{Br_2 / H_2O}$
- Uttarakhand Board 2022
5. Arrange the following compounds as directed :
- In increasing order of solubility in water : $(CH_3)_2NH, CH_3NH_2, C_6H_5NH_2$
 - In decreasing order of basic strength in aqueous solution : $(CH_3)_3N, (CH_3)_2NH, CH_3NH_2$
 - In increasing order of boiling point : $(C_2H_5)_2NH, (C_2H_5)_3N, C_2H_5NH_2$
- CBSE-2020
6. Arrange the following compounds in the increasing order of their property indicated: (Any two)
- Aniline, CH_3-NH_2 , p-nitroaniline (Basic strength)
 - $C_6H_5NH_2, C_6H_5NHCH_3, C_6H_5CH_2NH_2$ (Basic strength)
 - $C_2H_5NH_2, (C_2H_5)_2NH, C_6H_5NH_2$ (Solubility in water)
- CBSE-2022
7. (a) Write equations involved in the following reactions :
- Ethanamine reacts with acetyl chloride.
 - Aniline reacts with bromine water at room temperature.
 - aniline reacts with chloroform and ethanolic potassium hydroxide.
- CBSE-2022
8. b (i) Write the IUPAC name for the following organic compound : $(CH_3CH_2)_2NCH_3$
- (ii) Write the equations for the following :
- Gabriel phthalimide synthesis
 - Hoffmann bromamide degradation
- CBSE-2022
9. (a) Write reasons for the following :
- Ethylamine is soluble in water whereas aniline is insoluble.
 - Amino group is o-and p-directing in aromatic electrophilic substitution reactions, but aniline on nitration gives a substantial amount of m-nitroaniline.
 - Amines behave as nucleophiles.
- CBSE-2022
10. Give reasons :
- Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.
 - Aniline does not give Friedel-Crafts reaction.
 - Although $-NH_2$ group is o/p directing in electrophilic substitution reactions, yet aniline on nitration gives good yield of m-nitroaniline.
- CBSE-2022
11. Arrange the following compounds as directed: (any Two)
- In decreasing order of basic strength in aqueous solution : $C_2H_5NH_2, (C_2H_5)_2 NH, (C_2H_5)_3 N$
 - In increasing order of solubility in water : $(C_2H_5)_2 NH, C_2H_5NH_2, C_6H_5NH_2$
 - In decreasing order of their pK_b values : $C_6H_5NH_2, C_2H_5NH_2, NH_3$
- CBSE-2022
12. (a) Aromatic primary amines cannot be prepared by Gabriel Phthalimide synthesis. Why ?
- (b) Aniline is a weaker base than alkyl amines. Why ?
- (c) Arrange the following in the increasing order of basic strength in aqueous solution :
- $$(CH_3CH_2)_2NH, (C_2H_5)_3N, C_2H_5NH_2$$
- CBSE-2022
13. A compound 'A' on reduction with iron scrap and hydrochloric acid gives compound 'B' with molecular formula C_6H_7N . Compound 'B' on reaction with $CHCl_3$ and alcoholic KOH produces an obnoxious smell of carbylamine due to the formation of 'C'. Identify 'A', 'B' and 'C' and write the chemical reactions involved.
- CBSE-2022
14. (a) Complete the following :
- $CH_3CN \xrightarrow[2. H_2O]{1. AlH(i-Bu)_2} 'A' \xrightarrow[H^+]{H_2N-OH} 'B'$
 - Write IUPAC name of the following compound :
-
- (iii) Write chemical test to distinguish between the following compounds : Phenol and Benzoic acid.
- CBSE-2022
15. Account for the following :
- pK_b of aniline is more than that of methylamine.
 - Aniline does not undergo Friedel-Crafts reaction.
 - Primary amines have higher boiling points than tertiary amines.
- CBSE-2022
16. (i) Arrange the following compounds in the increasing order of their basic strength in aqueous solution :
- $$CH_3NH_2, (CH_3)_3N, (CH_3)_2NH$$

- (ii) What is Hinsberg's reagent ?
 (iii) What is the role of pyridine in the acylation reaction of amines ?

CBSE-2022

17. Complete the following reactions:



CBSE-2019

18. Write the structures of main products when benzene diazonium chloride reacts with the following reagents :

- (a) CuCN
 (b) $\text{CH}_3\text{CH}_2\text{OH}$
 (c) KI

CBSE-2019

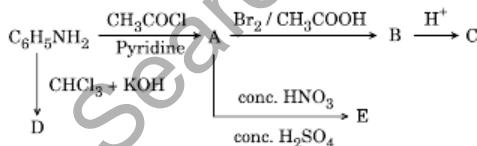
19. (a) Write the product formed when
 (i) 2-chloropropane is treated with alc. KOH
 (ii) Aniline reacts with conc. H_2SO_4 at 435–473 K.
 (d) When aniline is heated with CHCl_3 and alc. KOH, a foul smelling compound is formed. What is this compound?

CBSE-2019

20. An aromatic compound 'A' on heating with Br_2 and KOH forms a compound 'B' of molecular formula $\text{C}_6\text{H}_7\text{N}$ which on reacting with CHCl_3 and alcoholic KOH produces a foul smelling compound 'C'. Write the structures and IUPAC names of compounds A, B and C.

CBSE-2019

21. Write the structures of A, B, C, D and E in the following reactions :

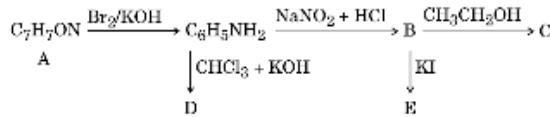


CBSE-2019

22. (a) Write the product formed when
 (i) 2-chloropropane is treated with alc. KOH.
 (ii) Aniline reacts with conc. H_2SO_4 at 453 – 473 K.
 (d) When aniline is heated with CHCl_3 and alc. KOH, a foul smelling compound is formed. What is this compound?

CBSE-2019

23. An aromatic compound (A) of molecular formula $\text{C}_7\text{H}_7\text{ON}$ undergoes a series of reactions as shown below. Write the structures of A to E in the following reactions:



CBSE-2019

24. Arrange the following substances:
 $\text{C}_6\text{H}_5\text{NH}_2, (\text{C}_2\text{H}_5)_2\text{NH}, (\text{C}_2\text{H}_5)_3\text{N}, \text{C}_2\text{H}_5\text{NH}_2$
 (i) In an increasing order of basic strength in water .
 (ii) In a decreasing order of basic strength in gas phase .

Foreign 2008

25. State reasons for the following:
 (i) pK_b value for aniline is more than that of methylamine.
 (ii) Ethylamine is soluble in water whereas aniline is not soluble in water.
 (iii) Primary amines have higher boiling points than tertiary amines.

All India 2011, 2010C;

Foreign 2010; Delhi 2009C, 2008

26. (i) Arrange the following compounds in an increasing order of basic strength: $\text{C}_6\text{H}_5\text{NH}_2, \text{C}_6\text{H}_5\text{N}(\text{CH}_3)_2, (\text{C}_2\text{H}_5)_2\text{NH}$ and CH_3NH_2
 (ii) Arrange the following compounds in a decreasing order of pK_b values:
 $\text{C}_2\text{H}_5\text{NH}_2, \text{C}_6\text{H}_5\text{NHCH}_3, (\text{C}_2\text{H}_5)_2\text{NH}$ and $\text{C}_6\text{H}_5\text{NH}_2$

All India 2014C

27. Give reasons
 (i) Aniline is a weaker base than cyclohexyl amine.
 (ii) It is difficult to prepare pure amines by ammonolysis of alkyl halides.

All India 2013C

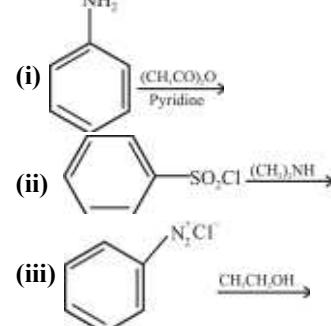
28. How can you prepare methyl amine by Hofmann bromamide reaction? Write the action of methyl amine with (i) CHCl_3 and alcoholic KOH solution and (ii) methyl iodide?

Odisha Board-2020

29. Arrange the following amines in the increasing order of their basicity:

Odisha Board-2020

30. (a) Write the structures of the main products of the following reactions :



- (b) Give a simple chemical test to distinguish between aniline and N, N-dimethyl aniline
 (c) Arrange the following in the increasing order of their pK_b values $\text{C}_6\text{H}_5\text{NH}_2, \text{C}_2\text{H}_5\text{NH}_2, \text{C}_6\text{H}_5\text{NHCH}_3$.

UP Board-2018

- 31.(i) Amines are basic in nature.
Arrange the following compounds in the increasing order of their basic strength.
 NH_3 , $\text{C}_6\text{H}_5\text{NH}_2$, $\text{CH}_3\text{-NH}_2$, $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$.
- (ii) How will you convert aniline ($\text{C}_6\text{H}_5\text{NH}_2$) to chlorobenzene?
32. Write chemical reactions to prepare ethanamine from
(i) acetonitrile
(ii) nitroethane
- Kerala Board-2016, 2013
33. How can the following conversions be brought about:
(i) How will you distinguish between primary, secondary and tertiary amines by Hinsberg's test?
- Maharashtra board-2022
34. Why do primary amines have higher boiling point than tertiary amines?
- Chhattisgarh Board-2020
35. What is carbylamines test for 1° amine?
- Haryana Board-2017
36. Aliphatic amines stronger base than aromatic amines, explain.
- Haryana Board-2017
37. Among Aniline and Methylamine which has higher value of pK_b and why?
- Haryana Board-2016
- 38.(a) Alkyl amines are more basic than ammonia. Explain.
(b) Identify and write chemical formula of [A] and [B] in the following sequence of reaction:
- $$\text{C}_6\text{H}_5\text{NO}_2 \xrightarrow[Sn+\text{HCl}]{6[\text{H}]} [\text{A}] \xrightarrow[273-278\text{K}]{\text{NaNO}_2+\text{HCl}} [\text{B}]$$
- Rajasthan Board-2020
39. Draw the resonating structure of Aniline.
- Rajasthan Board-2018
40. Draw the resonating structures of Urea.
- Rajasthan Board-2018
41. Arrange the following compounds in increasing order of their basic strength. Explain reason:
 $\text{C}_6\text{H}_5\text{NH}_2$, NH_3 , $\text{C}_6\text{H}_5\text{NH}_2$
- Rajasthan Board-2015
42. Alkanamine is more basic than ammonia. Give reasons.
- Rajasthan Board-2013
43. Write the chemical name and formula of Hinsberg's reagent.
- Rajasthan Board-2013
44. The melting point of p-nitrophenol is higher than o-nitrophenol. Explain why.
- Rajasthan Board-2011
45. How will you distinguish primary and secondary amines by Hinsberg reagent?
- Rajasthan Board-2010
46. Draw the intermolecular hydrogen bonding in primary amine.
- Rajasthan Board-2010
47. Arrange the following in increasing order of their basicity:
 NH_3 , $\text{C}_6\text{H}_5\text{NH}_2$, $(\text{CH}_3)_2\text{NH}$, CH_3NH_2 .
- Rajasthan Board-2010
48. Arrange the following in decreasing order of the pK_b values:
 $\text{C}_2\text{H}_5\text{NH}_2$, $\text{C}_6\text{H}_5\text{NHCH}_3$, $(\text{C}_2\text{H}_5)_2\text{NH}$ and $\text{C}_6\text{H}_5\text{NH}_2$
- Assam Board-2020
49. Account for the following:
(i) Ethylamine is soluble in water whereas aniline is not.
- Assam Board-2019
50. Account for the following:
(ii) Methylamine in water reacts with ferric chloride to precipitate hydrated ferric oxide.
- Assam Board-2019
51. Give one chemical test to distinguish between the following pairs of compounds:
(i) Methylamine and dimethylamine
- Assam Board-2019
52. Aniline does not undergo Friedel-Crafts reaction. Why?
- Assam Board-2019
53. Arrange the following compounds in the increasing order of their basic strength in aqueous solution:
 NH_3 , $\text{C}_2\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$, $(\text{C}_2\text{H}_5)_3\text{H}$.
- Assam Board-2018
54. Arrange the following in decreasing order of their basic strength:
 $\text{C}_6\text{H}_5\text{NH}_2$, $\text{C}_2\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$, NH_3
- Assam Board-2017
55. pK_b of aniline is more than that of methylamine. Why?
- Assam Board-2013
56. Write one chemical test to distinguish between methylamine and dimethylamine.
- Assam Board-2012

Section-D : Case Based Study

1. Aminos are usually formed from nitro compounds, halides, amides imides, etc. They exhibit hydrogen bonding which influences their physical properties. In alkyl amines, a combination of electron releasing, steric and hydrogen bonding factors influence the stability of the substituted ammonium cations in protic polar solvents and thus affect the basic nature of amines. In aromatic amines, electron releasing and withdrawing groups respectively increase and decrease their basic character. Influence of the number of hydrogen atoms at nitrogen atom on the type of reactions and nature of products is responsible for identification and distinction between primary, secondary and tertiary amines. Presence of amino group in aromatic ring enhances reactivity of the aromatic amines. Aryl diazonium salts provide advantageous methods for producing aryl halides, cyanides, phenols and arenes by reductive removal of the diazo group.

Answer the following questions:

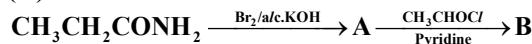
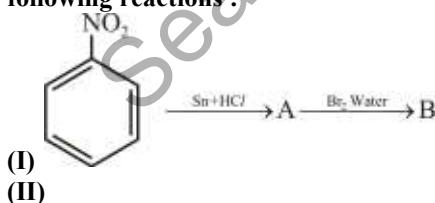
- Arrange the following in the increasing order of their pK_b values in aqueous solution:
 $C_2H_5NH_2, (C_2H_5)_2NH, (C_2H_5)_3N$
- Aniline on nitration gives a substantial amount of m-nitroaniline, though amino group is o/p directing. Why?
- An aromatic compound 'A' of molecular formula $C_7H_6O_2$ on treatment with aqueous ammonia and heating forms compound 'B'. Compound 'B' on heating with Br_2 and aqueous KOH gives compound 'C' of molecular formula C_6H_7N . Write the structures of A, B and C.

Gujarat Board 2023 (July)

2. Read the following passage and answer the questions that follow :

Amines constitute an important class of organic compounds derived by replacing one or more hydrogen atoms of ammonia molecule by alkyl/aryl groups. Amines are usually formed from nitro compounds, halides, amides, etc. They exhibit hydrogen bonding which influences their physical properties. Alkyl amines are found to be stronger bases than ammonia. In aromatic amines, electron releasing and withdrawing groups, respectively increase and decrease their basic character. Reactions of amines are governed by availability of the unshared pair of electrons on nitrogen. Influence of the number of hydrogen atoms at nitrogen atom on the type of reactions and nature of products is responsible for identification and distinction between primary, secondary and tertiary amines. Reactivity of aromatic amines can be controlled by acylation process.

- Why does aniline not give Friedel-Crafts reaction ?
- Arrange the following in the increasing order of their pK_b values:
 $C_6H_5NH_2, NH_3, C_2H_5NH_2, (CH_3)_3N$
- How can you distinguish between $CH_3CH_2NH_2$ and $(CH_3CH_2)_2NH$ by Hinsberg test ?
- (a) Write the structures of A and B in the following reactions :



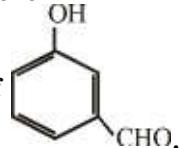
- (b) How will you convert the following:

- Benzoic acid to aniline
- Aniline to p-bromoaniline

CBSE-2022

3. (a) How are the following conversions carried out ?
- Aniline to Phenol
 - Ethanal to Propan-2-ol

- (b) Give chemical tests to distinguish between the following pairs of compounds :
- n-propyl alcohol and Isopropyl alcohol
 - Phenol and Benzyl alcohol



- (c) Write IUPAC name of

An organic compound of molecular formula $C_6H_5O_3Na$, is heated with CO_2 at 400K gives compound A of molecular formula $C_7H_5O_3Na$. Compound (A) on treating with HCl gives (B). (B) on further reaction with NaOH/CaO gives compound (C) of molecular formula C_6H_6O which on treatment with nitrous acid at 200 K gives compound (D). Identify (A), (B), (C) and (D) and explain the reactions

Tamil Nadu Board-2015

5. An element (A) belongs to group number 11 and period number 4 (A) is a reddish brown metal. (A) reacts with HCl in the presence of air and gives compound (B). (A) also reacts with conc. HNO_3 to give compound (C) with the liberation of NO_2 . Identify (A), (B) and (C). Explain the reactions.

Tamil Nadu Board-2011

Section-E : Long Answer

1. (a) Give reasons :
- Although $-NH_2$ group is o/p directing in electrophilic substitution reactions, yet aniline, on nitration gives good yield of m-nitroaniline.
 - $(CH_3)_2 NH$ is more basic than $(CH_3)_3 N$ in an aqueous solution.
 - Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.
- (b) Distinguish between the following :
- $CH_3CH_2NH_2$ and $(CH_3CH_2)_2 NH$
 - Aniline and CH_3NH_2

CBSE-2020

2. Arrange the following in increasing order of their basic strength.
- $C_6H_5NH_2, C_6H_5N(CH_3)_2, (C_2H_5)_2NH$
 - Aniline, p-nitro aniline, p-toluidine
 - $C_6H_5NH_2, C_6H_5NHCH_3, C_6H_5CH_2NH_2$

Gujarat Board-2021

3. Distinguish between primary, secondary and tertiary amines.

4. a) Between CH_3NH_2 and $C_6H_5NH_2$ which is more base? Give reason
 b) i) Name the main product when aniline is heated with alcoholic KOH and chloroform.
 ii) Give the IUPAC name of $(CH_3)_2N - C_2H_5$.
 c) Complete the Chemical equation.

Karnataka Board-2019

5. a) How primary amine is prepared by Hoffmann bromamide degradation?
 b) i) Write IUPAC name of $CH_3CH_2NH_2$

7. Among the following compounds, the most reactive towards electrophilic nitration is:
- Benzoic acid
 - Nitrobenzene
 - Toluene
 - Benzene

NIOS Board-2019

Ans. (c)

8. Oxidation of aniline with acidified potassium dichromate gives:
- Benzaldehyde
 - P-benzo quinone
 - Benzyl alcohol
 - Benzoic acid

Tamil Nadu Board-2018

Ans. (b)

9. The reaction among primary amine, chloroform and alcoholic caustic potash is called
- Wurtz reaction
 - Fraenklund reaction
 - Cannizzaro reaction
 - Carbylamine reaction

NIOS Board-2016

Ans. (d)

10. Alkyl Cyanide upon reduction with Na/ethanol gives
- CH_3NH_2
 - $(\text{CH}_3)_3\bar{\text{N}}$
 - CH_3NHCH_3
 - $\text{CH}_3\text{CH}_2\text{NH}_2$

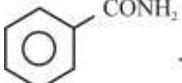
Punjab Board-2021

Ans. (a)

11. $\text{CH}_3\text{CONH}_2 \xrightarrow{\text{Br}_2/\text{KOH}} \text{P}$, P is :
- CH_3CN
 - CH_3NH_2
 - CH_3Br
 - CH_3OH

Haryana Board-2022

Ans. (b)

12.  $\xrightarrow[\Delta]{\text{H.O}^+} \text{P}$, P is:
- Benzoic acid
 - Aniline
 - Benzonitrile
 - Benzylamine

Haryana Board-2016

Ans. (a)

13. Which is Gattermann reagent?
- Cu/NaNO_2
 - Red P/KI
 - Cu powder/HBr
 - CuBr/HBr

Gujarat Board-2016

Ans.(c)

14. Which product does not form by Sand Mayer reagent from benzene diazonium chloride?
- Benzene nitrile
 - Bromobenzene
 - Iodobenzene
 - Chlorobenzene

Gujarat Board-2016

Ans.(a)

15. Which of the following reaction gives secondary amine?
- Reduction of carbylamine
 - Reduction of nitro compound

- Reduction of amide
- Hoffmann reduction

Gujarat Board-2018

Ans.(a) :

16. $\text{R}-\text{CN} + \text{SnCl}_2 + \text{HCl} \rightarrow \text{product}$.

Which is the product in above reaction?

- Amide
- Amine
- Imine
- Oxime

Gujarat Board-2018

Ans. (b)

17. Which compound by reduction with LiAlH_4 will give secondary amine?

- Nitroethane
- Ethyl isocyanide
- Ethanamide
- Ethanenitrile

Gujarat Board-2019

Ans. (b)

18. Which compound will give carbylamine test?

- Benzylamine
- Diphenylamine
- N,N-dimethylaniline
- N-methyl benzenamine

Gujarat Board-2019

Ans. (a)

19. Which product is obtained when 2 mole of methyl chloride is reacted with methyl amine?

- N, N-Dimethylethanamine
- N-Ethylmethanamine
- N-Methylethanamine
- N, N-Dimethylmethenamine

Gujarat Board-2020

Ans. (d)

20. $\text{CH}_3 - \text{CN} \xrightarrow{\text{Na/C}_2\text{H}_5\text{OH}} \text{product}$, the product is

- $\text{CH}_3 \cdot \text{CH}_2 \cdot \text{NH}_2$
- $\text{CH}_3 \cdot \text{NH}_2$
- $\text{CH}_3 \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{NH}_2$
- None of these

Jharkhand Board-2018

Ans. (a)

Section-B : Very Short Answer

1. Explain following :

- Hoffman bromide reaction.

MP Board 2020

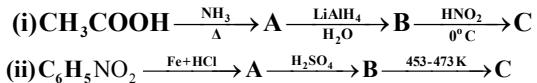
2. Write an isomer of $\text{C}_3\text{H}_9\text{N}$ which gives foul smell of isocyanide when treated with chloroform and ethanolic NaOH.

CBSE-2020

3. (b) Describe Hinsberg method for the identification of primary, secondary and tertiary amines.

CBSE-2022

4. (b) Write the structures of A, B and C in the following :



CBSE-2022

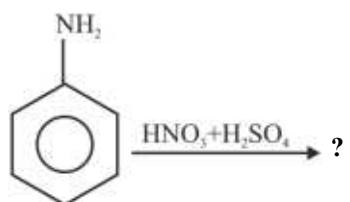
5. Write the reaction involved in the Hoffmann bromamide degradation reaction.

CBSE-2019

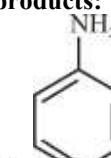
6. Propanamine and N,N-dimethylmethanamine contain the same number of carbon atoms, even though Propanamine has higher boiling point than N,N-dimethylmethanamine. Why ? CBSE-2019
7. Give balanced equation for the following name reaction:
Balz-Schiemann's reaction
ISC Board-2014
8. Complete the following reaction and name the reaction:

$$\text{C}_3\text{H}_7\text{NH}_2 + \text{CHCl}_3 + 3\text{KOH}(\text{alc.}) \xrightarrow{\Delta} \dots + 3\text{KCl} + 3\text{H}_2\text{O}$$

ISC Board-2012
9. When acetamide is treated with bromine and caustic soda, it gives as the main product and the reaction is called
ISC Board-2011
10. Give the balanced equation for the following: Acetamide is heated with sodium hydroxide.
ISC Board-2011
11. Convert.
(i) Nitrobenzene to phenol.
(ii) Aniline to chlorobenzene.
Delhi 2011C
12. How will you convert.
(i) Aniline to benzonitrile?
(ii) Ethanamine to ethanoic acid?
Delhi 2011C
13. How will you bring about the following conversions?
(i) Methylamine into iodomethane.
(ii) Chlorobenzene into p-chloroaniline.
Delhi 2011C
14. Give a chemical test to distinguish between
(i) methylamine and dimethylamine.
(ii) aniline and N-methylaniline.
Delhi 2010, 2008; Foreign 2009
15. How are the following conversions carried?
(i) Aniline to nitrobenzene.
(ii) Ethanamine to N-ethylethanamide.
Foreign 2009
16. Account methylamine in water reacts with ferric chloride to give a precipitate of ferric hydroxide.
All India 2008
17. Write equations for
(i) Gabriel phthalimide reaction
(ii) Hofmann bromamide reaction
Foreign 2011
18. Write down carbylamines reaction.
Punjab Board-2017
19. Write preparation of phenol from aniline
Maharashtra board-2022
20. The reaction in which an amide is converted into a primary amine by the action of Br_2 and alcoholic NaOH is known as _____.
Kerala Board-2019
21. Direct nitration of aniline is not possible, why? Explain with equation. How nitration of aniline is done?
Chhattisgarh Board-2021
22. Describe how Sandmeyer reaction can be used as a method for converting aniline to chlorobenzene.
Manipur Board-2022
23. Benzamide, $\text{C}_6\text{H}_5\text{CONH}_2$ on reduction with LiAlH_4 followed by hydrolysis gives an amine. It also undergoes Hofmann's bromamide reaction (with Br_2/KOH) and forms amine. What will be the difference between the two amines ?
Manipur Board-2022
24. What is carbylamine reaction?
Andhra Pradesh Board-2021
25. Write chemical equation of carbylamines reaction.
Rajasthan Board-2019
26. Write the reactions of (i) aliphatic and (ii) aromatic primary amines with nitrous acid.
Rajasthan Board-2014
27. (a) Complete and name the following reactions:
(i) $\text{RNH}_2 + \text{CHCl}_3 + \text{KOH}_{\text{alc}} \longrightarrow$
(ii) $\text{RCONH}_2 + \text{Br}_2 + \text{NaOH} \longrightarrow$
(b) Give reason why the aromatic amines are weaker bases than aliphatic amines.
Assam Board-2012
28. What is the name of reaction for preparation of methyl isocynide.
MP Board-2016
29.
$$\text{C}_6\text{H}_5\text{NH}_2 + \text{CHCl}_3 + 2\text{KOH} \xrightarrow[\text{Solution}]{\text{Alcoholic}} \text{C}_6\text{H}_5\text{NC} + 3\text{KCl} + 3\text{H}_2\text{O}$$

MP Board-2012
30. Complete the reaction
(i) $\text{CH}_3\text{CONH}_2 + 4[\text{H}] \xrightarrow{\text{LiAlH}_4/\text{ether}} ?$
(ii)

 $\xrightarrow{\text{HNO}_3 + \text{H}_2\text{SO}_4} ?$
Nagaland Board-2018

Section-C : Short Answer

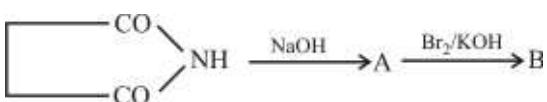
1. Complete the following reactions giving main products:

(1) $+ \text{Br}_2(\text{aq}) \longrightarrow$
Gujarat Board 2023 (July)
For Questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

- (b) Both Assertion (A) and Reason (R) true, but Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is true, but Reason (R) is false
 (d) Assertion (A) is false, but Reason (R) is true.
2. Assertion (A) : Monobromination of aniline can be conveniently done by protecting the amino group by acetylation.
 Reason (R) : Acetylation decreases the activating effect of the amino group.
 Gujarat Board 2023 (July)
3. Give reasons :
 (a) Aniline does not undergo Friedel-Crafts reaction.
 (b) Aromatic primary amines cannot be prepared by Gabriel's phthalimide synthesis.
 (c) Aliphatic amines are stronger bases than ammonia.
 CBSE-2020
4. Account for the following:
 (a) Aniline is a weaker base compared to ethanamine.
 (b) Aniline does not undergo Friedel-Crafts reaction.
 (c) Only aliphatic primary amines can be prepared by Phthalimide synthesis.
 CBSE-2020
5. (a) How will you distinguish between the following pairs of compounds:
 (i) Aniline and Ethanamine
 (ii) Aniline and N-methylaniline
 (b) Arrange the following compounds in decreasing order of their boiling points:
 Butanol, Butanamine, Butane
 CBSE-2020
6. Write the equations involved in the following reactions:
 (a) Carbylamine reaction
 (b) Hoffmann bromamide degradation reaction
 CBSE-2021
7. (a) (i) Why does aniline not give Friedel-Crafts reaction ?
 (ii) Write the equation involved in carbylamine reaction.
 (iii) Write the structures of A and B in the following:
- $$\text{Benzyl carbamate} \xrightarrow{\text{Br}_2 + \text{KOH (aq.)}} \text{A} \xrightarrow[\text{Pyridine}]{(\text{CH}_3\text{CO})_2\text{O}} \text{B}$$
- CBSE-2022
8. (a) Write the reactions involved in the following :
 (i) Hoffmann bromamide degradation reaction
 (ii) Gabriel phthalimide synthesis
 (iii) Carbylamine reaction
 CBSE-2022
9. Write the chemical equations involved when aniline is treated with the following reagents :
 (Any two)
 (i) $\text{CH}_3\text{COCl}/\text{Pyridine}$
 (ii) Br_2 water
 (iii) HCl
- CBSE-2022
10. Illustrate the following reactions giving suitable example in each case :
 (i) Gabriel phthalimide synthesis.
 (ii) Carbylamine reaction.
 (iii) Hoffmann bromamide degradation reaction.
 CBSE-2022
11. Write short notes on :
 (a) Carbylamine reaction
 (b) Sandmeyer reaction
 Telangana Board-2017
12. Write equations of the following reactions :
 (i) Acetylation of aniline
 (ii) Coupling reaction
 (iii) Carbyl amine reaction
 CBSE-2019
13. Complete the following reaction equations:
 (i) $\text{C}_6\text{H}_5\text{NH}_2 + \text{CH}_3\text{COCl} \longrightarrow$
 (ii) $\text{C}_2\text{H}_5\text{NH}_2 + \text{C}_6\text{H}_5\text{SO}_2\text{Cl} \longrightarrow$
 (iii) $\text{C}_2\text{H}_5\text{NH}_2 + \text{HNO}_2 \longrightarrow$
 All India 2009
14. Write chemical equation for the following conversions:
 (i) Nitrobenzene to benzoic acid.
 (ii) Benzyl chloride to 2-phenylethanamine.
 (iii) Aniline to benzyl alcohol.
 Delhi 2012
15. Give one chemical test each to distinguish between the compounds in the following pairs:
 (i) Methylamine and dimethylamine.
 (ii) Aniline and benzylamine.
 (iii) Ethylamine and aniline.
 All India 2011, 2010; Foreign 2009, 2008
16. Write the main products of the following reactions:
 (i) $\text{CH}_3\text{CH}_2\text{NH}_2 \xrightarrow[0^\circ\text{C}]{\text{HNO}_2}$

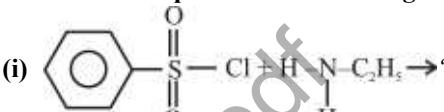
$$\text{(ii)} \quad \begin{array}{c} \text{O} \\ \parallel \\ \text{S}-\text{Cl} \end{array} + \text{H}-\text{N}-\text{C}_2\text{H}_5 \longrightarrow \begin{array}{c} \text{O} \\ \parallel \\ \text{S}-\text{C}_2\text{H}_5 \end{array}$$

$$\text{(iii)} \quad \begin{array}{c} \text{O} \\ \parallel \\ \text{S}-\text{C}_2\text{H}_5 \end{array} + \text{CH}_3-\text{C}-\text{Cl} \longrightarrow \begin{array}{c} \text{O} \\ \parallel \\ \text{S}-\text{C}_2\text{H}_5 \end{array} \text{C}_2\text{H}_5\text{Cl}$$

 All India 2013
17. Give the structures of A, B and C in the following reactions:
 (i) $\text{CH}_3\text{Br} \xrightarrow{\text{KCN}} \text{A} \xrightarrow{\text{LiAlH}_4} \text{B} \xrightarrow[273\text{K}]{\text{HNO}_2} \text{C}$
 (ii) $\text{CH}_3\text{COOH} \xrightarrow[\Delta]{\text{NH}_3} \text{A} \xrightarrow{\text{Br}_2 + \text{KOH}} \text{B} \xrightarrow{\text{CHCl}_3 + \text{NaOH}} \text{C}$
 All India 2014

18. How will you convert the following?
 (i) Nitrobenzene into aniline.
 (ii) Ethanoic acid into methanamine.
 (iii) Aniline into N-phenylethanamide.
 (Write the chemical equations involved).
 All India 2014
19. Write short notes on the following—
 (a) Diazotisation
 (b) Reduction of Amides
 Uttarakhand Board-2020
20. Explain carbylamines reaction with an example.
 Telangana Board-2023
21. Explain the reaction of Aniline with Nitrous acid.
 Telangana Board-2023
22. Explain Carbylamine reaction.
 Odisha Board-2017
23. Complete the following reaction and write the names of A and B.

 Odisha Board-2017
24. What happens when nitrobenzene reacts with conc. HNO_3 in the presence of conc. H_2SO_4 ?
 Odisha Board-2017
25. Explain Schotten-Baumann reaction.
 Tamil Nadu Board-2015
26. Identify the compounds X, Y and Z in the following sequence of reactions:

$$\begin{array}{c} \text{C}_6\text{H}_5\text{NH}_2 \xrightarrow[\text{273-278K}]{\text{NaNO}_2, \text{HCl}} \text{X} \xrightarrow{\text{CuBr/HBr}} \text{Y} \\ \xrightarrow[\text{anhy, AlCl}_3]{(\text{CH}_3\text{CO})_2\text{O}} \text{Z} \text{(major product)} \end{array}$$

 Manipur Board-2017
27. Out of benzene, m – dinitrobenzene and toluene, which will undergo nitration most easily and Why? Arrange them in decreasing ease of nitration.
 NIOS Board-2018
28. An organic compound (A) $\text{C}_7\text{H}_6\text{O}$ has the smell of bitter almonds. Compound (A) reacts with ammonia to give compound (B) $\text{C}_{21}\text{H}_{18}\text{N}_2$. Compound (A) Also reacts with dilute alcoholic KCN to form Compound (C) $\text{C}_{14}\text{H}_{12}\text{O}_2$. Identify (A), (B) and (C). Explain the reactions.
 Tamil Nadu Board-2018
29. Giving example for each explain the following reactions :
 (i) Hofmann's bromamide reaction
 (ii) Wolffkishner reduction
 NIOS Board-2022
30. Name the important Oxo acid of Nitrogen.
 Kerala Board-2021
31. How can the following conversions be brought about:
 (i) Acetaldehyde to propan-2-ol.
 (ii) Nitrobenzene to p-aminoazobenzene .
 (iii) Acetic acid to methylamine.
 (iv) Aniline to benzene.
 ISC Board-2017
32. An aromatic compound (A) on treatment with aqueous ammonia and heating forms a compound (B). Which on heating with Br_2 and KOH forms a compound (C) of molecular formula $\text{C}_6\text{H}_7\text{N}$. Write the structures and IUPAC names of compounds A, B and C.
 Assam Board- 2020
 Assam Board-2014
33. Methanamine can be prepared using Gabriel phthalimide synthesis. Write chemical equation only for the synthesis.
 Assam Board-2014
34. Toluene is more easily nitrated than benzene. Explain.
 Haryana Board-2017
35. Write the main products of following reactions:
 (i) 
 (ii) 
36. (a) Describe the following
 (i) Gabriel phthalimide synthesis
 (ii) Coupling reaction
 Haryana Board-2016
37. Write the following reactions with chemical equations—

$$\left[\frac{1}{2} + \frac{1}{2} = 3 \right]$$

 (a) Carbyl-amine reaction
 (b) Hoffmann Bromamide reaction
 Uttarakhand Board-2019
38. Convert the following:
 (iii) Aniline to Phenylisocyanide
 Haryana Board-2016
39. Identify [A] ad [B] in the following chemical reactions.

$$\text{C}_6\text{H}_5\text{N}_2^+ \text{Cl}^- \xrightarrow[\text{NaNO}_2 \text{ (Aqueous)}]{\text{Cu(Powder)}} [\text{A}] \xrightarrow[\text{6[H]}]{\text{Sn[HCl}}} [\text{B}]$$

 Rajasthan Board-2019
40. Complete the following equation and identify A and B.

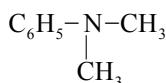
$$\text{C}_6\text{H}_5\text{NO}_2 \xrightarrow[\text{6H}]{\text{Sn/HCl}} [\text{A}] \xrightarrow{\text{NaNO}_2 + \text{HCl}} [\text{B}]$$

 Rajasthan Board-2018
41. Complete the following equations and identify A and B.

$$\text{R}-\underset{\text{O}}{\overset{\parallel}{\text{C}}}-\text{NH}_2 \xrightarrow{\text{Br}_2 + \text{KOH}} [\text{A}] \xrightarrow[\text{H}]{\text{CHCl}_3 + \text{KO}} [\text{B}]$$

 Rajasthan Board-2018
42. An alkylamine (A) molecular formula CH_5N undergoes carbylaminies reaction to give (B). When (B) is reduces with LiAlH_4 gives (C). Identify (A), (B) and (C).
 Tamilnadu Board, Sep.-2016

8. a) Explain carbyl amine reaction with equation.
b) How does nitrobenzene is reduced to aniline
c) Write the IUPAC name of

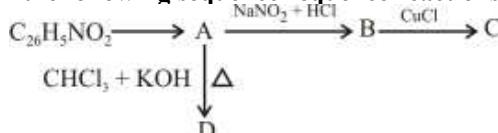


Karnataka Board-2018

9. a) Explain the mechanism of addition of HCN to a carbonyl group in presence of a base.
b) How is benzamide obtained from benzoic acid?

Karnataka Board-2016

10. (a) Nitrobenzene undergoes a series of reactions as shown below. Write the structures and names of A, B, C and D in the following sequence requence reactions:



- (b) Give chemical test to distinguish between primary, secondary and tertiary alcohols.

NIOS Board-2023

11. Explain the following giving one suitable example of each. Give chemical equation.
(i) Hofmann bromamide reactoin
(ii) Cannizaro reaction

NIOS Board-2023

12. Explain the reaction of arylamine with
(a) Acylation in presence of pyridine catalyst
(b) Ethyl Iodide
(c) CHCl_3/KOH

Gujarat Board-2019

13. Write chemical equations for the conversion of each of the following:
(a) Acetamide to methylamine.
(b) Benzene diazonium chloride to phenol.
(c) Aniline to sulphanilic acid.

Goa Board-2018

14. a) Write the equation to convert Aniline into 4-Bromo aniline (P-bromo aniline).
b) Explain the preparation of primary amines by Hoffmann's bromamide degradation reaction.

Karnataka Board-2020

15. a) Name the major product formed when nitrous acid is treated with
i) methylamine
ii) aniline at low temperature.
b) Explain the Hoffmann's bromamide reaction.
c) Write the IUPAC name of
 $(\text{CH}_3)_2\text{N}-\text{CH}_2-\text{CH}_3$. (2 + 2 + 1)

Karnataka Board-2015

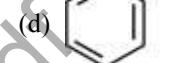
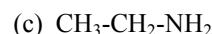
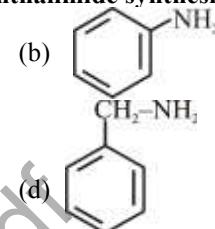
16. (a) (i)Explain the reduction of nitro compounds to amines with an example.
(ii) Why aromatic primary amines cannot be prepared by Gabriel synthesis?
(b) How is aniline converted into phenyl isocyanides ? Write the equation. (3 + 2)

Karnataka Board-2016

17. a) Explain Hoffmann bromamide degradation for the preparation of methanamine.
b) Name major organic product formed in the following conversion.
i) What nitrous acid is treated with methylamine.]
ii) Benzene diazonium chloride is treasted with KI .
c) Which is more basic among methyl amine and aniline?

Karnataka Board-2017

18. Which of the following amine cannot be prepared by Gabriel Phthalimide synthesis ?



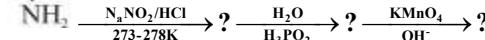
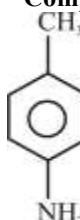
- (ii) Explain the method to distinguish primary, secondary and tertiary amines. Also write the chemical equations involved.

Kerala Board-2021

19. (a) Account for the following observations:
(i) Aniline does not undergo Friedel Crafts reaction.
(ii) p_{K_b} for aniline is more than that for methylamine.
(b) Give a chemical test to distinguish between Methylamine and Dimethylamine.

Haryana Board-2016

20. Complete the following:



Haryana Board-2018

24. Compound [A] is an aromatic amine which react with NaNO_2+HCl at 273-278 km and form compound [B]. Compound [B] react with HBF_4 and the obtained product on further heating, in the presence of NaNO_2 and cu form compound [C]. Compound [C] reduced in the presence of SnHCl to reformed compound [A]. Write general name of 'A', 'B' and 'C' and write equation of all reaction involved.

Rajasthan Board-2017

22. Write that reaction which is used for following.
(a) Ascent of amine series.
(b) To synthesis amine containing one carbon less than that of in the amide.

Rajasthan Board-2016

23. Write following organic conversion with appropriate conditions is three steps. 4-Bromo Aniline from aniline.

Gujarat Board-2019

24. Explain Carbyl Amine Test giving reactions.
Gujarat Board-2020

25. Explain why :

 - (i) pK_b value of aniline is more than that of methylamine.
 - (ii) Ethyl amine is soluble in water but aniline is not.
 - (iii) Aniline does not undergo Friedel-Craft reaction.

Assam Board-2023

F. Method of Preparation of Diazonium Salts

Section-A : Multiple Choice Questions

Gujarat Borad-2022 (July)

Ans. (d)

2. When aqueous solution of benzene diazonium chloride is boiled, the product formed is

 - (a) Benzyl alcohol
 - (b) Benzene + N₂
 - (c) Phenol
 - (d) Phenyl hydroxyl amine

Tamil Nadu Board-2011

Ans. (c)

3. Nitromethane condenses with acetaldehyde to give

 - (a) nitropropane
 - (b) 1-nitro-2-propanol
 - (c) 2-nitro-1-propanol
 - (d) 3-nitropropanol.

Tamil Nadu Board-2011

Ans. (b)

4. Nitro-acinitro tautomerism is exhibited by

 - (a) nitromethane
 - (b) nitrobenzene
 - (c) chloropicrin
 - (d) O-toluidine

Tamil Nadu Board-2011

Ans. (a)

5. Which of the following will not undergo diazotization?

 - (a) m-toluidiene
 - (b) aniline
 - (c) p-amino phenol
 - (d) benzyl amine

Tamil Nadu Board-2016

Ans (d)

6. The reaction which converts benzene diazonium chloride to chlorobenzene using CuCl in HCl is known as —

 - (a) Swarts reaction
 - (b) Sandmeyer reaction
 - (c) Finkelstein reaction
 - (d) Kolbe's reaction

Kerala Board-2022

Ans. (b)

Section-B : Very Short Answer

1. Write the product when benzene diazonium chloride reacts with ethanol. CBSE-2020
 2. How can the following conversion be brought about?
Nitrobenzene to benzene diazonium chloride. ISC Board-2013
 3. Convert benzene to benzene diazonium chloride. ISC Board-2016
 4. Write a chemical reaction in which iodide ion displaces diazonium group from a diazonium

All India 2008

5. What are diazonium salts? Manipur Board-2017

6. What is Diazotisation reaction ? Haryana Board-2021

7. Write the formula of benzene diazonium chloride.

MT B

Section-C : Short Answer

- (a) Diazonium salts of aromatic amines are more stable than those of aliphatic amines.

(b) Methylamine in water reacts with ferric chloride to precipitate hydrated ferric oxide.

Arrange the following in decreasing order of pK_b giving reason:

- (c) Aniline, p-nitroaniline and p-toluidine
(d) $C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$ in gaseous state

CBSE-2019

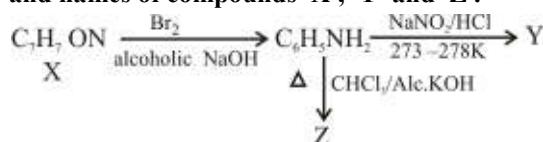
2. How will you bring about the following transformations ?

(a) Ethyl alcohol to Ethyl chloride
(b) Acetylene to acetaldehyde
(c) Aniline to Benzene diazonium chloride.

3. (i) Coupling reaction of benzene diazonium chloride with phenol is carried out in basic condition, but the same basic condition cannot be used in the coupling reaction with aniline. Explain.
(ii) Write the IUPAC name of the nitro compound, $C_6H_5NO_2$ which does not react with nitrous acid.

Manipur Board-2019

4. An aromatic compound 'X' having molecular formula C_7H_7ON undergoes a series of reactions as shown below. Write the formulae and names of compounds 'X', 'Y' and 'Z'.

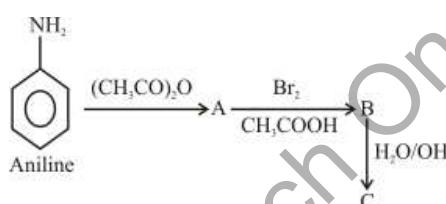


Goa Board-2019

5. How Benzene diazonium chloride is prepared?
Or
What are Amines? Give their classification.
- J & K board-2023
6. Explain, with the help of chemical equations, how the following compounds would be obtained from benzene diazonium chloride :
(i) Iodobenzene
(ii) 4 - Aminoazobenzene

Meghalaya Board-2018

7. Complete the following reaction :



What will happen if aniline is treated with aqueous bromine ?

Meghalaya Board-2018

Section-E : Long Answer

1. (a) Write the structures of A and B in the following reactions :
(i) $C_6H_5N_2^+Cl^- \xrightarrow{\text{CuCN}} A \xrightarrow{H_2O/H^+} B$
(ii) $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{\text{NaOBr}} B$
(b) Write the chemical reaction of methyl amine with benzoyl chloride write the IUPAC name of the product obtained.
(c) Arrange the following in the increasing order of their pK_b values :
 $C_6H_5NH_2, NH_3, C_2H_5NH_2, (C_2H_5)_2 NH$

CBSE-2020

2. (a) The compound 'A' is obtained by diazotization of amiline. It undergoes diazo coupling reaction with phenol to give 'B'. Write the reaction and also the names of 'A' and 'B'.
(b) The common painkiller aspirin is obtained by reacting a compound 'X' with acetic anhydride. Identify 'X'. How is it prepared from phenol ? Write the reaction and also write the names of the compounds formed in the first two steps of the reaction.

NIOS Board-2022

G. Importance of Diazonium Salt and Synthesis of Aromatic Compound

Section-A : Multiple Choice Questions

1. Which salt is insoluble in water?
(a) $C_6H_5N_2^+HSO_4^-$ (b) $C_6H_5N_2^+BF_4^-$
(c) $C_6H_5N_2^+Br^-$ (d) $C_6H_5N_2^+Cl^-$

Gujarat Board 2023 (March)

Ans. (b)

2. Which of the following undergoes diazotisation?
(a) Aniline (b) Methylamine
(c) Ethylamine (d) All of these

ISC Board-2017

Ans. (d)

3. Which of the following compounds has the smell of bitter almonds?
(a) Aniline
(b) Nitromethane
(c) Benzene sulphonic acid
(d) Nitrobenzene

Tamil Nadu Board-2011

Ans. (b)

4. Which of the following will not dissolve in NaOH?
(a) CH_3NO_2
(b)
$$\begin{array}{c} CH_3 - CH - NO_2 \\ | \\ CH_3 \\ | \\ CH_3 \end{array}$$

(c)
$$\begin{array}{c} CH_3 - C - NO_2 \\ | \\ CH_3 \end{array}$$

(d) $CH_3 - CH_2 - CH_2 - NO_2$

Tamil Nadu Board-2016

Ans. (a)

5. The formation of cyanohydrins from a ketone is an example of:
- Electrophilic addition
 - Nucleophilic addition
 - Nucleophilic substitution
 - Electrophilic substitution

Tamil Nadu Board-2016

Ans. (b)

6. The product obtained when nitrobenzene is reduced using Zn/NaOH is:
- Azobenzene
 - Aniline
 - Hydrazobenzene
 - Azoxy benzene

Tamil Nadu Board-2018

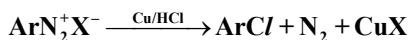
Ans. (c)

7. Out of following which substance will not give diazotization reaction?
- | | |
|-------------------|-------------------|
| (a) p-Aminophenol | (b) Methanamine |
| (c) Benzenamine | (d) o-Aminophenol |

Gujarat Board-2019

Ans. (c)

8. What is the name of this reaction?



- Coupling reaction
- Balz-Schiemann Reaction
- Gattermann reaction
- Sendmeyer reaction

Haryana Board-2022

Ans. (c)

9. _____ nitro compounds behave as acids in presence of strong alkali.
- | | |
|-----------------|---------------|
| (a) Primary | (b) Secondary |
| (c) (a) and (b) | (d) Tertiary |

Tamilnadu Board, Sep.-2016

Ans. (c)

10. When benzene diazonium chloride reacts with N,N-dimethyl aniline at ice cold condition gives
- P- aminoazobenzene
 - Diazoaminobenzene
 - P-dimethyl aminoazobenzene
 - P-methyl aminoazobenzene

Tamilnadu Board, March-2016

Ans. (c)

11. Electrophile used in the nitration of benzene is:
- | | |
|-------------------|--------------------|
| (a) Hydronium ion | (b) Sulphonic acid |
| (c) Nitronium ion | (d) Bromide ion |

Tamilnadu Board, March-2016

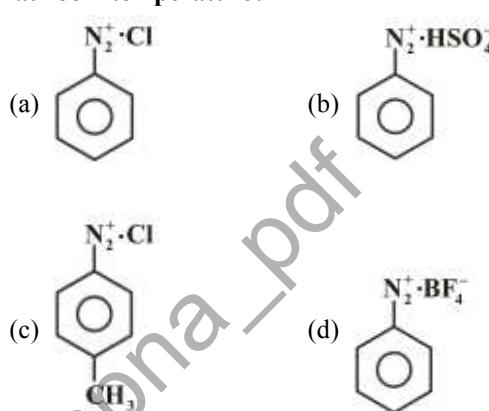
Ans. (c)

12. Give the correct order of proportion of products obtained by nitration of aniline.
- o-nitroaniline > p-nitroaniline >m-nitroaniline
 - m-nitroaniline o-nitroaniline > p-nitroaniline
 - m-nitroaniline > p-nitroaniline > onitroaniline
 - p-nitroaniline> m-nitroaniline > o-nitroaniline

Gujarat Board-2018

Ans.(d) :

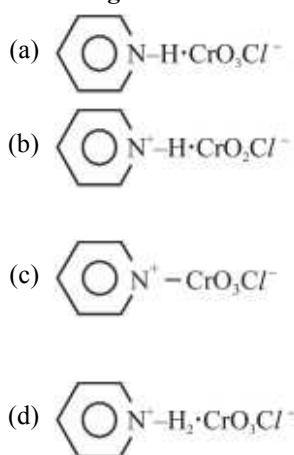
13. Which of the following Diazonium salt is stable at room temperature?



Gujarat Board-2018

Ans.(d) :

14. Identify Pyridinium chlorochromate from the following.



Gujarat Board-2018

Ans.(a) :

15. Which of the following will not give halo benzene by reacting with benzene diazonium chloride?
- | | |
|--|---------------------|
| (a) Cu ₂ Br ₂ /HBr | (b) KI |
| (c) SnCl ₂ +HCl | (d) Cu powder + HCl |

Gujarat Board-2017

Ans.(c)

Section-B : Very Short Answer

1. Write down chemical equations to prepare orange and yellow dye from diazonium salt.
Gujarat Board 2023 (March)
2. Explain the following:
(i) Diazonium salts of aromatic amines are more stable than those of aliphatic amines
Manipur Board 2020
3. Write chemical formula of benzene diazonium chloride.
Rajasthan Board 2023
4. Write the name of the product when benzene diazonium chloride is treated with KI.
CBSE-2020
5. How can the following conversion be brought about?
Nitrobenzene to 2, 4, 6-tribromoaniline.
ISC Board-2014
6. State the reactions and reaction conditions for the following conversions:
(i) Benzene diazonium chloride to nitrobenzene.
(ii) Aniline to benzene diazonium chloride.
Foreign 2008
7. Complete the following reaction equations:
(i) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} + \text{H}_3\text{PO}_2 + \text{H}_2\text{O} \longrightarrow$
(ii) $\text{C}_6\text{H}_5\text{NH}_2 + \text{Br}_2 \text{ (aq)} \longrightarrow$
All India 2012
8. Illustrate the following with an example of reaction in each case:
(i) Sandmeyer's reaction.
(ii) Coupling reaction.
Delhi 2011C
9. Give a chemical test to distinguish between aniline and N-methylaniline.
All India 2010
10. Why electrophilic substitution takes place more readily in aromatic amines than benzene?
Delhi 2010C
11. Complete the following reaction.
 $\text{C}_6\text{H}_5\text{N}_2\text{Cl} + \text{H}_3\text{PO}_2 + \text{H}_2\text{O} \longrightarrow$
Delhi 2015C
12. How is the following conversion carried out:
Aniline to p-hydroxyazobenzene.
Delhi 2012C
13. An amine is synthesized by Gabriel phthalimide synthesis. Compare its basicity with aniline.
Manipur Board-2019
14. What happens when benzene diazonium chloride reacts with potassium iodide? (write only equation of the reaction)
Rajasthan Board-2015

15. Write the coupling reaction of benzene diazonium chloride with phenol.

Rajasthan Board-2014

16. Match the pair correctly:

- | | |
|----------------------|--|
| "A" | "B" |
| (a) Diazonium salt | (i) Explosive |
| (b) Gas Mask | (ii) $\text{C}_6\text{H}_5\text{N}_2\text{Cl}$ |
| (c) Philosopher wool | (iii) Radioactive halogen |
| (d) Astatine | (iv) ZnO |
| (e) T.N.B. | (v) Adsorption of poisonous gases |

MP Board-2018

17. Write the name of reaction.



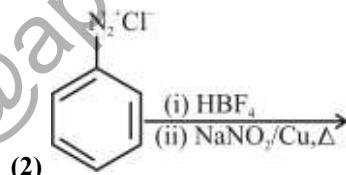
MP Board-2012

18. $\text{C}_6\text{H}_5\text{NO}_2 + 6[\text{H}] \xrightarrow{\text{Sn/HCl}} \dots \text{X} \dots + 2\text{H}_2\text{O}$ Write the formula of X.

MP Board-2012

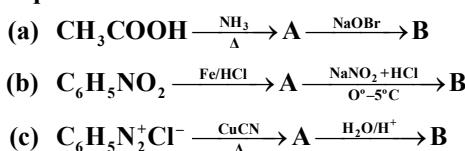
Section-C : Short Answer

1. Complete the following reactions giving main products:



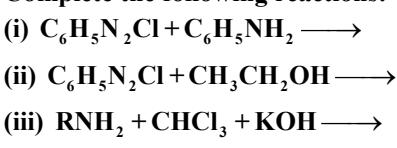
Gujarat Board 2023 (July)

2. Give the structures of A and B in the following sequence of reactions



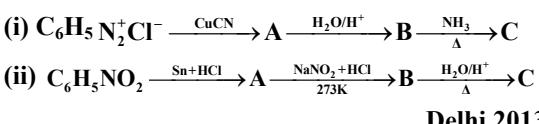
CBSE-2020

3. Complete the following reactions:



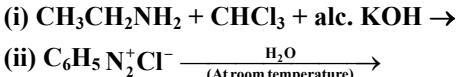
Delhi 2010; Foreign 2010

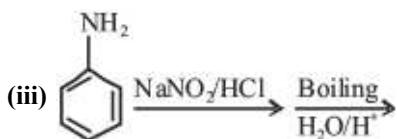
4. Give the structures of A, B and C in the following reactions:



Delhi 2013

5. Complete the following reaction:



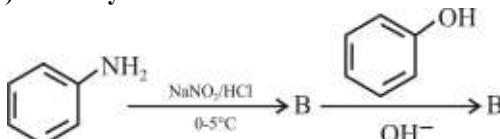


All India 2013

6. An aromatic compound 'A' on treatment with aqueous ammonia and heating forms compound 'B' which on heating with Br_2 and KOH forms a compound 'C' of molecular formula $\text{C}_6\text{H}_7\text{N}$. Write the structure and IUPAC names of compounds A, B and C.

Delhi 2015C

7. (a) Identify A and B.



- (b) Write only the chemical reactions of the following: (any one)

- (i) Carbylamine reaction
(ii) Hoffmann bromamide reaction

Assam Board-2022

8. An organic compound A of molecular formula $\text{C}_2\text{H}_5\text{ON}$ treated with bromine and KOH gives B of molecular formula CH_5N . Identify A and B. Write the equation involved.

Tamil Nadu Board-2011



Identify A, B and C.

Tamil Nadu Board-2016

10. How will you bring about the following transformations?

- (a) Nitrobenzene to Aniline
(b) Formaldehyde to Methyl alcohol
(c) Propanone to Tri-iodomethane,

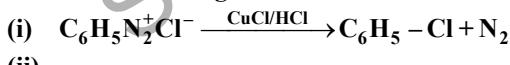
Jharkhand Board-2020

11. Convert Benzenediazonium chloride into:

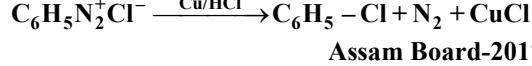
- (i) Benzene
(ii) Phenol
(iii) Iodobenzene

Haryana Board-2016

12. Name the following reactions:

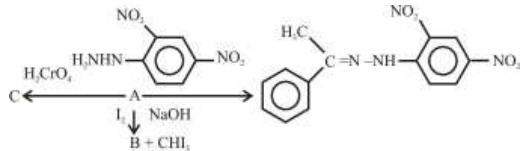


(ii)



Assam Board-2017

13. (a) Identify the compounds A, B and C in the following reaction:



Meghalaya Board-2021

Section-E : Long Answer

1. An aromatic compound 'X' having molecular formula $\text{C}_7\text{H}_7\text{ON}$ undergoes a series of reactions as shown below. Write the formulae and names of compounds 'X', 'Y' and 'Z'.

Goa Board-2023

2. (a) Explain the reduction of nitrobenzene in
(i) Acid medium
(ii) neutral medium
(iii)electrolytic reduction

Tamil Nadu Board-2015

3. Write the chromogen, and auxochrome present in para hydroxyl azo benzene.

Tamil Nadu Board-2018

4. How can you convert aniline to p-nitroaniline? Give the chemical equations only.

Assam Board-2014

5. How do you prepare the following compounds from benzene diazonium chloride?

- (a) Nitrobenzene
(b) Chlorobenzene
(c) Phenyl hydrazine

Tamilnadu Board, Sep.-2016

6. Write a note on the reduction of nitrobenzene under alkaline medium.

Tamilnadu Board, March-2016

20. Give the diazotisation reaction of aniline. Also give the chemical reaction involved in the preparation of red azo dye and light yellow azo dye.

Gujarat Board-2018

21. How will you convert aniline into phenol? Give necessary chemical equations.

Assam Board-2016

22. An organic compound A($\text{C}_7\text{H}_5\text{N}$) on hydrolysis with strong aqueous acid gives another compound B which is a monobasic aromatic carboxylic acid. The compound B on treatment with ammonia gives a salt which on heating gives C. The compound C undergoes Hofmann's bromamide reaction to yield aniline. Name A, B and C and write the chemical reactions involved.

Assam Board-2013

14.

Biomolecules

A. Carbohydrates

Section-A : Multiple Choice Questions

1. Which polysaccharide is highly branched?
 (a) amylopectin (b) glycogen
 (c) amylose (d) cellulose

Gujarat Board 2023 (March)

Ans. (b)

2. Which one acts as non reducing sugar?
 (a) maltose (b) lactose
 (c) glucose (d) sucrose

Gujarat Board 2023 (March)

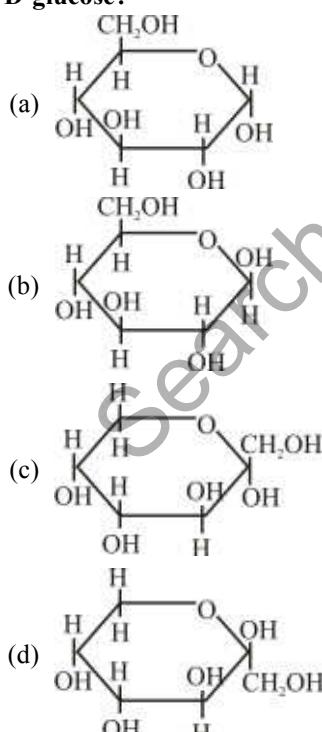
Ans. (d)

3. On hydrolysis, which of the following carbohydrates gives glucose and galactose?
 (a) Sucrose (b) Lactose
 (c) Maltose (d) Cellulose

Gujarat Board 2023 (July)

Ans. (b)

4. Which of the following structures represents α -D-glucose?



Gujarat Board 2023 (July)

Ans. (a)

5. _____ is not reducing sugar?

- (a) Maltose (b) Sucrose
 (c) Lactose (d) Amylose

Gujrat Borad-2022 (July)

Ans. (b)

6. Which reaction will prove the presence of aldehyde group in glucose?

- (a) $C_6H_{12}O_6 + HCN \longrightarrow$
 (b) $C_6H_{12}O_6 + HI \xrightarrow{\Delta} \longrightarrow$
 (c) $C_6H_{12}O_6 + Br_2 \xrightarrow{H_2O} \longrightarrow$
 (d) $C_6H_{12}O_6 + (CH_3CO)_2O \longrightarrow$

Gujarat Borad-2022 (July)

Ans. (c)

7. Which of the following is a disaccharide?

- (a) Glucose
 (b) Starch
 (c) Cellulose
 (d) Lactose

CBSE-2020

Ans. (d)

8. α -D(+)-glucose and β -D(+)-glucose are

- (a) Geometrical isomers
 (b) Enantiomers
 (c) Anomers
 (d) Optical isomers

CBSE-2020

Ans. (c)

9. An α -helix is a structural feature of

- (a) Sucrose (b) Polypeptides
 (c) Nucleotides (d) Starch

CBSE-2020

Ans. (b)

10. Which of the following is a non-reducing sugar?

- (a) Sucrose (b) Maltose
 (c) Glucose (d) Lactose

CBSE-2020

Ans. (a)

11. Peptide linkage is present in

- | | |
|-------------------|--------------|
| (a) Carbohydrates | (b) Vitamins |
| (c) Proteins | (d) Rubber |

CBSE-2020

Ans. (c)

12. Which reagent gives saccharic acid by reacting with glucose?

- | | |
|---------------------------|----------------------|
| (a) Br ₂ water | (b) HNO ₃ |
| (c) NH ₂ OH | (d) Fehlig solution |

Gujarat Board-2017

Ans. (b)

13. The pair of sugars which give the same product with excess of phenylhydrazine are

- | |
|---------------------------|
| (a) Starch and cellulose |
| (b) Cellulose and sucrose |
| (c) sucrose and glucose |
| (d) glucose and fructose |

ISC Board-2002

Ans. (d)

14. Glucose on treatment with NH₂OH undergoes.

- | | |
|------------------|---------------|
| (a) Condensation | (b) Reduction |
| (c) Hydrolysis | (d) Oxidation |

ISC Board-2004

Ans. (a)

15. Which of the following is an example of disaccharide?

- | | |
|-------------|---------------|
| (a) Glucose | (b) Fructose |
| (c) Sucrose | (d) Cellulose |

ISC Board-2015

Ans. (c)

16. Which carbohydrate is tetrasaccharide?

- | | |
|---------------|---------------|
| (a) Stachyose | (b) Maltose |
| (c) Raffinose | (d) Cellulose |

Gujarat Board-2018

Ans. (a)

17. How many Chiral Carbons are present in Fructose?

- | | |
|-------|-------|
| (a) 1 | (b) 3 |
| (c) 2 | (d) 4 |

Gujarat Board-2020

Ans. (b)

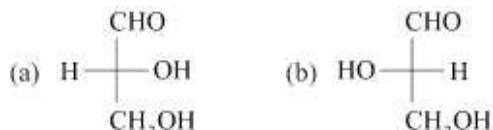
18. Which glycosidic linkage is present in Maltose?

- | |
|---|
| (a) β -D-(+)-glucose (C ₁)—O—(C ₄)—D-(+)-glucose |
| (b) α -D-(+)-glucose (C ₁)—O—(C ₄)—D-(+)-glucose |
| (c) α -D-(+)-glucose (C ₁)—O—(C ₂)— β -D-(+)-glucose |
| (d) β -D-(+)-glucose (C ₁)—O—(C ₄)—D-(+)-glucose |

Gujarat Board-2018

Ans.(d) :

19. Which of the following is the structure of D-Glyceraldehyde?



- | | |
|----------|-------------------|
| (c) Both | (d) None of these |
|----------|-------------------|

Gujarat Board-2021

Ans. (a)

20. The number of secondary alcohol present in fructose is:

- | |
|-------|
| (a) 4 |
| (b) 2 |
| (c) 0 |
| (d) 3 |

Tamil Nadu Board-2015

Ans. (a)

21. Glucose form —With acetic anhydride and sodium acetate

- | | |
|-------------------|-------------------|
| (a) Di acetate | (b) Tetra acetate |
| (c) Penta acetate | (d) Hexa acetate |

Tamil Nadu Board-2015

Ans. (c)

22. The intermolecular hydrogen bonding is present in

- | |
|-------------------|
| (a) o-nitrophenol |
| (b) m-nitrophenol |
| (c) p-nitrophenol |
| (d) none of these |

Tamil Nadu Board-2011

Ans. (c)

23. Mixture of equal molecules of D (+) glucose and D (-) fructose is called as

- | | |
|-----------------|------------------|
| (a) Fruit sugar | (b) Invert sugar |
| (c) Cane sugar | (d) Non-sugar |

Tamil Nadu Board-2011

Ans. (b)

24. What are the products obtained during hydrolysis of Raffinose?

- | |
|----------------------------------|
| (a) Sucrose, Fructose, Lectose |
| (b) Glucose, Fructose, Galactose |
| (c) Fructose, Lactose, Galactose |
| (d) Maltose, Lactose, Sucrose |

Tamil Nadu Board-2016

Ans. (b)

25. Sucrose is not:

- (a) Hydrolysed to only glucose
- (b) A disaccharide
- (c) Hydrolysed to glucose and fructose
- (d) A non-reducing sugar

Tamil Nadu Board-2018

Ans. (a)

26. The disaccharides present in milk is

- (a) sucrose
- (b) maltose
- (c) lactose
- (d) cellulose

Nagaland Board-2020

Ans. (c)

27. Which is the General formula of Trisaccharide?

- (a) $C_nH_{2n-6}O_{n-3}$
- (b) $C_nH_{2n-2}O_{n-1}$
- (c) $C_nH_{2n-4}O_{n-2}$
- (d) $C_nH_{2n-3}O_{n-1}$

Gujarat Board-2019

Ans. (c)

28. Disaccharide is:

- (a) Starch
- (b) Fructose
- (c) Lactose
- (d) Cellulose

Haryana Board-2022

Ans. (a)

29. Ribose is a

- (a) monosaccharide
- (b) polysaccharide
- (c) polypeptide
- (d) Disaccharide

Nagaland Board-2018

Ans. (a)

30. Glycogen is an example of :

- (a) Polysaccharide
- (b) Disaccharide
- (c) Monosaccharide
- (d) Protein

Haryana Board-2019

Ans. (a)

31. In the following which is not a Monosaccharide sugar ?

- (a) Glucose
- (b) Fructose
- (c) Mannose
- (d) Maltose

Haryana Board-2021

Ans. (d)

32. The number of primary and secondary hydroxyl groups in ribose are _____ respectively.

- (a) 1, 3
- (b) 2, 3
- (c) 3, 1
- (d) 3, 2

Maharashtra board-2018

Ans. (a)

33. Which enzyme helps in converting sucrose into glucose and fructose?

- (a) Lactase
- (b) Invertase
- (c) Urease
- (d) None of these

Jharkhand Board-2019

Ans. (b)

34. The artificial sweetener which is used in cold foods and soft drinks is

- (a) BHT
- (b) Aspartase
- (c) Sodium benzoate
- (d) Ranitidine

Kerala Board-2022

Ans. (b)

35. Glucose is an example of

- (a) Aldohexoses
- (b) Aldopentoses
- (c) Aldotetroses
- (d) None of these

Jharkhand Board-2020

Ans. (a)

36. Starch is a mixture of Amylopectin and

- (a) Pyran
- (b) Amylose
- (c) Lactose
- (d) D-Ribose

Haryana Board-2016

Ans. (b)

37. Reaction catalysed by enzyme 'Maltose'.

- (a) Starch → Maltose
- (b) Maltose → Glucose
- (c) Sucrose → Glucose
- (d) Glucose → Alcohol

MP Board-2015

Ans. (b)

38. Glucose is reducing sugar because the functional group present in it is

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
 (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
 (d) Assertion (A) is wrong, but Reason (R) is correct statement.
- CBSE-2020
- 18. What type of linkage is present in polysaccharides?**
- CBSE-2020
- 19. Name an artificial sweetener whose use is limited to cold drinks.**
- CBSE-2020
- 20. Assertion : Despite having an aldehydic group glucose does not give 2, 4-DNP test.**
- Reason:** Glucose is a reducing sugar.
- (a) Assertion and Reason both are correct statements and Reason is the correct explanation of the Assertion.
 (b) Assertion and Reason both are correct statements, but Reason is not the correct explanation of the Assertion.
 (c) Assertion is a correct statement, but Reason is a wrong statement.
 (d) Assertion is a wrong statement, but Reason is a correct statement.
- CBSE-2021
- 21. What happens when D-glucose is treated with the following ? Give equations to support your answer.**
- (a) HI
 (b) HNO_3
- Give any two points of difference between globular and fibrous proteins.
- CBSE-2019
- 22. What is the basic structural difference between starch and cellulose?**
- CBSE-2019
- 23. What are the hydrolysis products of lactose?**
- CBSE-2019
- 24. What are the hydrolysis products of sucrose?**
- 25. What is the basic structural difference between glucose and fructose ?**
- CBSE-2019
- 26. Write the products obtained after hydrolysis of lactose.**
- CBSE-2019
- 27. Name the carbohydrate used as storage molecule to store energy in animals.**
- CBSE-2019
- 28. Name a carbohydrate present in liver, muscles and brain.**
- CBSE-2019
- 29. What is the difference between a glycosidic linkage and a peptide linkage ?**
- CBSE-2019
- 30. How will you convert glucose to saccharic acid?**
- ISC Board-2009
- 31. How will you chemically convert glucose to fructose?**
- ISC Board-2001
- 32. How will you convert glucose to gluconic acid?**
- ISC Board-2003
- 33. Give a test to distinguish between starch and cellulose.**
- ISC Board-2006
- 34. Fill in the blanks.**
 Sucrose is a and yields upon hydrolysis, a mixture of and fructose,
- ISC Board-2017
- 35. What do you observe when glucose solution is heated with Tollen's reagent?**
- ISC Board-2016
- 36. Write the product obtained when D-glucose reacts with $\text{H}_2\text{N}-\text{OH}$.**
- All India 2015
- 37. Define the following term: Anomers.**
- All India 2014, Foreign 2014
- 38. Which of the two components of starch is water soluble?**
- All India 2014
- 39. What are the products of hydrolysis of sucrose?**
- All India 2013, 2010; Delhi 2014
- 40. What is a glycosidic linkage?**
- Delhi 2013; all India 2011, 2008C
- 41. What are the products of hydrolysis of lactose?**
- All India 2013; Delhi 2010C
- 42. Name two components of starch.**
- Delhi 2013C

72. Give an example of aldohexose.
Jharkhand Board-2019
73. Give the names of monosaccharides obtained when Maltose is hydrolyzed.
Haryana Board-2016
74. Sucrose is a —— and yields upon hydrolysis, a mixture of —— and fructose.
ISC Board-2017
75. Ketones are normally not reducing. Fructose however is reducing towards Fehling's solutions and Tollen's reagent in spite of the fact that it has ketonic group. Give reason.
Manipur Board-2019
76. Compare the two disaccharides, Sucrose and Maltose regarding their reducing/non reducing character.
Manipur Board-2022
77. Write a brief note on the structure of glucose.
Andhra Pradesh Board-2021
78. Write Fischer Projection Formula of erythrose sugar.
Rajasthan Board-2018
79. What are monosaccharides ?
Rajasthan Board-2014
80. Write that chemical reaction which confirm the presence of carbonyl group in glucose.
Rajasthan Board-2014
81. Give the name of sugar units obtained on hydrolysis of sucrose.
Rajasthan Board-2010
82. Name two carbohydrates which act as bio-fuels.
Assam Board-2016
83. Mention the hydrolysis products of sucrose.
Assam Board-2012
84. What is the name of Disaccharides Sugar present in milk.
MP Board-2016
85. Fill in the blanks:
Main product of mustard oil reaction is.....
MP Board-2016
86. What is Oil of mirbane.
MP Board-2015
87. What is the main product of mustard oil reaction?
MP Board-2013
88. Fill in the blanks:
(c) Starch is saccharids
MP Board-2013
89. Write one example of Monosaccharide Carbohydrate.
MP Board-2012
90. Explain the term :
(i) Zwitter ion
(ii) Oligosaccharides
Nagaland Board-2017
91. What will happen if a patient is given hypertonic solution of glucose ?
Meghalaya Board-2018

Section-C : Short Answer

1. (a) Write structure of D-glucose and fructose .
(b) Write chemical reaction of D-glucose with HI.
OR
(a) How do you explain the amphoteric behaviour of amino acids.
Uttarakhand Board 2022
2. Give the possible explanation for following:
(a) Glucose doesn't give 2, 4-DNP test.
(b) The two strands in DNA are not identical but are complementary.
(c) Starch and cellulose both contain glucose as monomer, yet they are structurally different.
CBSE-2020
3. Concentrated sulphuric acid is added followed by heating to each of the three test tubes (i) to (iii) containing cane sugar, copper turnings and sulphur powder respectively. Identify in which of the above test tubes the following changes will be observed Support your answer with the help of equations of chemical reactions.
(a) Disappearance of yellow powder along with evolution of colourless gas.
(b) Formation of black substance.
(c) Formation of a brown substance which on dilution becomes blue.
CBSE-2020
4. Define the following terms with a suitable example in each :
(i) Polysaccharides
(ii) Denatured protein
(iii) Fibrous protein
CBSE-2020
5. Define the following terms:
(i) Anomers
(ii) Peptide linkage
(iii) Denatured protein
CBSE-2021

6. What happens when glucose is treated with:
 (i) bromine water?
 (ii) HI?
 (iii) $\text{H}_2\text{N} - \text{OH}$?
CBSE-2021
7. (a) What are the products of hydrolysis of maltose ?
 (b) What type of bonding provides stability to α -helix structure of protein?
 (c) Name the vitamin whose deficiency causes pernicious anaemia.
CBSE-2019
8. (a) What happens when D-glucose is treated with the following reagents:
 (b) HI
 (c) conc. HNO_3
 (d) What is the basic structural difference between starch and cellulose?
CBSE-2019
9. Write chemical reactions to show that open structure of D-glucose contains the following :
 (i) Straight chain
 (ii) Five alcohol groups
 (iii) Aldehyde as carbonyl group
CBSE-2019
10. (a) What happens when D-glucose is treated with the following reagents :
 (i) HI
 (ii) conc. HNO_3
 (b) What is the basic structural difference between starch and cellulose ?
CBSE-2019
11. Define the following terms:
 (a) Anomers
 (b) Denaturation of protein
 (c) Nucleotide
CBSE-2019
12. What happens when D-Glucose is treated with the following reagents :
 (a) Br_2 water
 (b) HCN
 (c) $(\text{CH}_3\text{CO})_2\text{O}$
CBSE-2019
13. Define the following terms with a suitable example of each :
 (a) Antacids
 (b) Artificial sweeteners
 (c) Anionic detergents
CBSE-2019
14. (a) Give any one property of glucose that cannot be explained by the open chain structure.
 (b) Compare amylase with amylopectin in terms of constituting structure.
 (c) Why do amino acids show amphoteric behaviour ?
CBSE-2019
15. (a) Which one of the following is a disinfectant ?
 0.2% solution of phenol or 1% solution of phenol
 (b) What is the difference between agonists and antagonists?
 (c) Write one example each of
 (i) Artificial sweetener
 (ii) Antacids
CBSE-2019
16. Define the following terms with a suitable example of each:
 (a) Antiseptics
 (b) Bactericidal antibiotics
 (c) Cationic detergents
CBSE-2019
17. Differentiation between following:
 (a) Fibrous protein and Globular protein
 (b) Essential amino acids and Non-essential amino acids
 (c) Amylose and Amylopectin
CBSE-2019
18. Define the following terms with a suitable example of each :
 (a) Anomers
 (b) Essential amino acids
 (c) Denaturation of protein
CBSE-2019
19. Define the following–
 (a) Reducing Sugar
 (b) Oligosaccharide
 (c) Protein
Uttarakhand Board-2020
20. Which reactions can not explain the open chain structure of glucose.
Gujarat Board-2016
21. Mesotartaric acid is an optically active compound with Chiral Carbon atoms. Justify.
Tamil Nadu Board-2015

22. Define the following with an example of each :
 (a) Polysaccharides
 (b) Denatured protein
 (c) Essential amino acids
- UP Board-2018
23. (a) Write the product when D-glucose reacts with conc. HNO_3 .
 (b) Amino acids show amphoteric behaviour. Why ?
 (c) Write one difference between α -helix and β -pleated structures of proteins.
- UP Board-2018
24. Represent sucrose and α -D-maltose in the form of Haworth structures.
- Manipur Board-2017
25. The heat evolved in the combustion of glucose (molar mass = 180 g mol⁻¹) is given in the equation as
 $\text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2(\text{g}) \rightarrow 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l})$
 $\Delta H_{\text{comb}} = -2840 \text{ kJ mol}^{-1}$
 How much energy will be required for the production of 1.08 g of glucose?
- NIOS Board-2023
26. Complete the following equations
 i) $\text{CH}_4 + 2\text{O}_2 \rightarrow$
 ii) $2\text{Fe}^{3+} + \text{SO}_2 + 2\text{H}_2\text{O} \rightarrow$
 iii) $\text{C}_{12}\text{H}_{22}\text{O}_{11} + \text{H}_2\text{SO}_4(\text{conc}) \rightarrow$
- Karnataka Board-2015
27. Write the formula (Configuration) for d,l and meso tartaric acid.
- Tamil Nadu Board-2016
28. What is peptisation ? Give one example.
- West Bengal Board-2019
29. Write commercial method for preparation of glucose. Write structure of adipic acid.
- Maharashtra board-2022
30. Give the open chain and ring structures of glucose and account for the existence of glucose in two anomeric forms.
- Kerala Board-2019
31. (i) What are oligosaccharides? Give an example.
 (ii) What is glycogen ?
 (iii) Explain the chemical constitution of starch.
- Kerala Board-2022
32. Define the terms:
 (a) Biomolecules
 (b) Carbohydrates
 (c) Reducing Sugars
- Haryana Board-2017
33. (a) What is the difference between a nucleoside and a nucleotide?
 (b) Write full name of DNA and RNA.
 (OR)
- Match Column-I to Column-II–**
- | Column-I | Column-II |
|-------------------|--|
| (i) Glucose | (1) Polysaccharide |
| (ii) Sucrose | (2) Loss of biological activity of Protein |
| (iii) Starch | (3) Energy transfer reagent |
| (iv) Denaturation | (4) Monosaccharide |
| (v) Chlorophyl | (5) Photosynthesis |
| (vi) A.T.P. | (6) Disaccharide |
- Uttarakhand Board-2019
34. Carbohydrates are broadly divided into monosaccharides, oligosaccharides and polysaccharides.
 (a) Write one example each of monosaccharide and oligosaccharide.
 (b) (i) Write any one method for the preparation of glucose.
 (c) (ii) What is peptide linkage?
- Kerala Board-2015
35. What is essentially the difference between α -glucose and β -glucose? What is meant by pyranose structure of glucose?
- Haryana Board-2018
36. Define the following terms:
 (a) Anomer
 (b) Peptide Bond
 (c) Reducing Sugar
- Haryana Board-2018
37. What happens when glucose reacts with bromine water? Give chemical equation.
- Rajasthan Board-2020
- 38.(a)What happens when glucose reacts with concentrated HNO_3 ? Give chemical equation.
 (b) Draw the structure of β -D-ribose sugar.
- Rajasthan Board-2019
39. Give the name of Enzyme used to convert glucose into ethanol.
- Rajasthan Board-2018
40. In which work saccharine is used.
- Rajasthan Board-2017
41. What are monosaccharides? Write the definition?
- Rajasthan Board-2016
- 42.(a) Write the Haworth structure of sucrose.
 (b) Sucrose is a non-reducing sugar. Why?
- Rajasthan Board-2013

43. Give the R-S configuration of glyceraldehydes.
Rajasthan Board-2010
44. Write the name and structural formula of a chiral molecule in which chiral centre is not present.
Rajasthan Board-2010
45. What are tetrasaccharides? Give its general formula and an example.
Gujarat Board-2018
46. Write only equation for the reactions for preparation of glucose from sugar and starch.
Gujarat Board-2017
47. What are carbohydrates? Give types of carbohydrates.
MP Board-2017
48. Define Carbohydrates and give their classification.
Or
What are Enzymes? Give their importance.
J & K board-2023
49. Out of sucrose and maltose, sucrose is a reducing sugar.
J & K Board-2021
- Section-D : Case Based Study**
- By giving equation of the reactions, confirm the presence of C=O , -CHO and five – OH groups in Glucose. Also give two chemical tests of glucose and fructose.
UP Board 2019
 - What do you mean by D and L configurations of carbohydrates. Draw the structural formula of D-Glucose and D-Fructose.
UP Board 2023
- Section-E : Long Answer**
- What happens when D-glucose is treated with HI? Explain with suitable reaction.
Gujarat Board-2021
 - How are carbohydrates classified? Give example for each.
Tamil Nadu Board-2011
 - Derive the structure of glucose in detail
Tamil Nadu Board-2011
 - Answer the following question:
 - A mixture of amylose and amylopectin is called ____.
 - Which hormone contains iodine?
 - What is freon used for?
Insert gas is used as beacon light.
 - Sulphide ores are concentrated by ____ process.
 - Write two factors that affect the rate of reaction.
 - Proteins are ____ type of colloids.
Odisha Board-2023
5. a) i) What is denaturation of protein?
ii) Give an example of acidic α -amino acid.
b) Write the Haworth's structure of α -D (+) Glucose.
Karnataka Board-2014
6. a) Write a chemical reactions to elucidate
i) Glucose contains five – OH groups.
ii) Glucose contains six carbon atoms in a straight chain.
b) Explain denaturation of proteins with example.
c) Name the sugar moiety present in DNA.
Karnataka Board-2020
7. a) Write the Haworth structure of maltose.
b) What is peptide linkages ? How many peptide bonds are present in a tetra-peptide?
c) Name the hormone which regulates blood sugar level in the body.
Karnataka Board-2019
8. a) Write Haworth structure, of "Lactose"
b) i) What are non-essential amino acids?
ii) Write Zwitter ionic structure of "glycine"
c) Name the nitrogenous base present in RNA but not DNA.
Karnataka Board-2018
9. a) Write the Haworth structure of maltose.
b) Give an example for
i) Globular proteins.
ii) Naturally occurring optically inactive amino acid,
c) Name the nucleic acid which is responsible for genetic information.
Karnataka Board-2017
10. a) How do you show that glucose contains a linear chain of six carbon atoms.
b) What are essential amino acids? Is glycine an essential amino acid?
c) Write the general formula of Zwitter ionic form of an amino acid.
Karnataka Board-2016

11. a) Write the Haworth structure for Maltose.
 b) What is meant by denaturation of proteins?
 Which level of structure remains intact during denaturation of globular proteins?
 c) Name the base present only in DNA but not in RNA.
- 2 + 2 + 1
Karnataka Board-2015
12. Write notes on polysaccharides.
Tamil Nadu Board-2018
13. (i) Write IUPAC name of the following compound :
- $$\begin{array}{c} \text{CH}_3 & \text{CH}_3 \\ | & | \\ \text{CH}_3-\text{CH}-\text{C}=\text{CH}_2 \end{array}$$
- (ii) Write chemical equation involved in Sandmeyer's reaction.
 (iii) Write the structure of main product when aqueous solution of bromine reacts with aniline.
 (iv) What are the products of hydrolysis of sucrose ?
- NIOS Board-2015**
14. a) Give the Haworth structure of lactose.
 b) What are hormones? Give an example.
 c) Which nitrogenous base present in DNA but not in RNA?
- Karnataka Board-2015**
15. a) Write Haworth structure of Maltose.
 b) What is nucleoside?
 c) What are fibrous proteins? Give an example
- Karnataka Board-2016**
16. a) Write Haworth structure of lactose.
 b) What are essential amino acids? Give an example.
- Karnataka Board-2017**
17. a) Write the Haworth structure of maltose.
 b) i) Name a naturally occurring α -amino acid which is optically inactive.
 ii) How many peptide bonds are present in a tripeptide?
 c) Deficiency of which Vitamin causes Night blindness?
- Karnataka Board-2019**
18. (i) Classify the following into monosaccharides and disaccharides. Ribose, Fructose Maltose, Sucrose.
 (ii) How is starch different from glycogen?
 (iii) Name the two hormones which work together to regulate glucose level in the body.
- Kerala Board-2021**
19. Cane sugar, Glucose and Starch are Carbohydrates.
 (a) Represent the structure of Glucose.
 (b) Write a method to prepare Glucose from Starch. Write the chemical equation of the reactions.
 (c) Suggest any two uses of Carbohydrates.
- Kerala Board-2016**
20. Name the three major classes of carbohydrates and give the distinctive characteristic of each class.
- Haryana Board-2016**
21. What happens when Glucose reacts with the following:
 (i) HI, Heat
 (ii) NH_2OH
 (iii) Br_2 Water
- Haryana Board-2018**
22. Outline the classification of Carbohydrates with suitable examples.
- Tamilnadu Board, March-2016**
23. Explain mutarotation in terms of glucose, (Structure is not necessary).
- Gujarat Board-2019**
24. Prove the presence of Aldehyde group in glucose molecule giving reaction? Write the name of product obtained.
- Gujarat Board-2020**
25. What are carbohydrates? Give the general formula of carbohydrates. Why polysaccharides are called non-sugars?
- Assam Board-2019**
26. A carbohydrate ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) is boiled with dil. H_2SO_4 in alcholic solution to form two hexoses with the same chemical formula. Identify the carbohydrate and the two hexoses. Give necessary chemical equations.
- Assam Board-2018**
27. What are carbohydrates? Give the general formula of carbohydrates. Why are polysaccharides called non-sugars?
- Assam Board-2015**
28. What are Carbohydrates ? How are they classified ?
- J&K Board-2020**

9. Name two fat soluble vitamins, their sources and the diseases caused due to their deficiency in diet.
All India 2009
10. Name two water soluble vitamins, their sources and diseases caused by their deficiency in diet.
Delhi 2009
11. What are vitamins? Deficiency of which vitamins cause convulsions and pernicious anaemia?
All India 2011C, 2010C
12. Answer the following questions:
 (i) Why are vitamin B and vitamin C essential for us?
 (ii) What is the difference between a nucleoside and a nucleotide?
Delhi 2014C
13. The deficiency of which vitamin causes the disease, pernicious anaemia?
All India 2011C
14. How are hormones and vitamins different in respect of their source and functions?
All India 2013C
15. Name the deficiency diseases resulting from lack of vitamin A and E in the diet.
Delhi 2013C, 2011C
16. Write the names of the vitamins, the deficiency of which
 (i) causes anemia and
 (ii) damages the reproductive system both in men and women.
Odisha Board-2020
17. Fresh tomatoes are a better source of vitamin C than those which have been stored for some time. Why?
Manipur Board-2017
18. Give an example for water soluble vitamin.
Karnataka Board-2020
19. Which vitamin deficiency causes the disease pernicious anaemia?
Karnataka Board-2019
20. Deficiency of which vitamin causes the disease "Rickets".
Karnataka Board-2018
21. Deficiency of which vitamin causes the disease scurvy.
Karnataka Board-2017
22. Deficiency of which vitamin causes the disease pernicious anaemia?
Karnataka Board-2015
23. Write chemical name and deficiency disease of Vitamin C.
Punjab Board-2019
24. Write the names of two vitamins soluble in fats.
Haryana Board-2022
25. The disease caused by deficiency of vitamin D is
Haryana Board-2022
26. Write the name of two vitamins which are soluble in fat.
Haryana Board-2022
27. is the deficiency disease of Vitamin 'D'.
Haryana Board-2021
28. Write the diseases caused by deficiency of vitamin K.
Jharkhand Board-2018
29. Give an example for fat soluble vitamin.
Karnataka Board-2017
30. Beri-beri occurs due to the deficiency of which vitamin?
Jharkhand Board-2019
31. Write the source of Vitamin A.
Jharkhand Board-2020
32. Write the name of two fat soluble vitamins. [1]
Uttarakhand Board-2019
33. Write the name of diseases due to deficiency of vitamins 'A' and vitamins 'B'.
Rajasthan Board-2017
34. Classify Vitamins A, B, C and D depending upon their solubility in water and fat and compare them.
Rajasthan Board-2014
35. Name one vitamin which is not soluble in water and fat.
Assam Board-2017
36. Name the source of vitamin E.
Assam Board-2016
37. Name the disease caused due to deficiency of vitamin K in our body.
Assam Board-2016
38. Name one water soluble vitamin.
Assam Board-2015
39. (a) Name the vitamin whose deficiency causes rickets.
 (b) Define the following terms in relation to protein:
 (i) Peptide linkage
 (ii) Denaturation
Assam Board-2013

2. Which parts of amino acids molecules are linked through hydrogen bonds in the secondary structure of proteins?

- (a) NH₂ group
- (b) COOH group
- (c) $\text{--C}=\text{O}$ and --NH-- groups
- (d) None of the above

CBSE-2020

Ans. (c)

3. Assertion (A): Albumin is a globular protein.

Reason (R): Polypeptide chain coils around to give a straight chain.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
- (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
- (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
- (d) Assertion (A) is incorrect, but Reason (R) is correct statement.

CBSE-2020

Ans. (c)

4. Which among the following is globular protein?

- (a) Albumin
- (b) Keratin
- (c) Collagen
- (d) None of above

Punjab Board-2021

Ans. (a)

5. Which among the following is secondary amine

- (a) CH₃NH₂
- (b) (CH₃)₃N
- (c) CH₃NHCH₃
- (d) CH₃CH₂NH₂

Punjab Board-2021

Ans. (c)

6. Which of the following gives carbon with concentrated H₂SO₄?

- (a) Ethyl alcohol
- (b) Starch
- (c) Formic acid
- (d) Oxalic acid

NIOS Board-2022

Ans. (b)

7. The bond that stabilises the secondary structure of protein is _____

- (a) covalent bond
- (b) coordinate bond
- (c) ionic bond
- (d) hydrogen bond

Goa Board-2018

Ans. (d)

8. The helix structure of proteins is stabilized by:

- (a) Peptide bond
- (b) hydrogen bond
- (c) disulphide bond
- (d) van der Waals forces

CBSE-2021

Ans. (b)

9. Ultimate products of hydrolysis protein is:

- (a) Aniline
- (b) Aliphatic acid
- (c) Amino acid
- (d) Aromatic acid

Tamilnadu Board, March-2016

Ans. (c)

10. Which is not found in R.N.A.

- (a) Thymine
- (b) Urecel
- (c) Adinine
- (d) Guwanine

MP Board-2016

Ans. (b)

Section-B : Very Short Answer

1. What is the effect of denaturation on the structure of proteins?

Gujarat Board 2023 (March)

2. Write the classification of protein according to molecular shape.

Gujarat Borad-2022 (July)

3. Give three differences between RNA and DNA.

MP Board 2020

4. Name the sugar formed when a nucleotide from DNA containing thymine is hydrolysed

Manipur Board 2020

5. Explain denaturation of protein.

Rajasthan Bobard 2022

6. What are fibrous protein? Name the protein present in hair.

Karnataka board 2023

7. Write name of any two Proteins.

Uttarakhand Board 2022

8. What type of protein is present in keratin ?
CBSE-2020
9. Write the products obtained after hydrolysis of DNA.
CBSE-2019
10. Write the products obtained after hydrolysis of DNA.
CBSE-2019
11. (a) Differentiate between Globular Proteins and Fibrous Proteins with a suitable example of each.
(b) Why should we always take milk and green vegetables in our diet ?
CBSE-2019
12. Differentiate between
(a) Nucleotide and Nucleoside
(b) Amylose and Amylopectin
CBSE-2019
13. Proteins are made up of units held together by linkages.
ISC Board-2004
14. Proteins are polymers of
ISC Board-2001
15. Correct the following statement. glycine exists as a zwitter ion at any pH.
ISC Board-2000
16. Write two differences between globular and fibrous proteins.
ISC Board-2017
17. Give one example of fibrous protein. Name the final product of hydrolysis of proteins. What is denaturation of proteins?
ISC Board-2000, 2010
18. Describe what do you understand by primary and secondary structure of proteins?
Delhi 2011; Foreign 2011
All India 2008
19. What is the biological effect of denaturation of proteins?
Delhi 2013, All India 2009C
20. What type of bonding helps in stabilizing the α -helix structure of proteins?
Delhi 2013
21. (a) What type of bonding helps in stabilizing the secondary structure of proteins?
(b) Answer the following questions: (any two)
- (i) How are vitamins classified? Name the vitamin deficiency of which causes scurvy.
(ii) What is glycogen? How is it different from starch?
(iii) Name the protein which is present in hair. What type of protein is this?
Assam Board-2022
22. Write a note on denaturation of protein.
Odisha Board-2020
23. Mention the differences between globular proteins and fibrous proteins.
Odisha Board-2023
24. What is the monomeric unit of protein? Give two examples of monomers, one of which contain sulphur. Give the Zwitterionic forms of them?
Manipur Board-2018
25. What do you mean by denaturation of a protein ? How does it affect properties of protein ?
Haryana Board-2019
26. Explain formation of peptide linkage in protein with an example.
Maharashtra board-2022
27. State two differences between globular and fibrous proteins.
Kerala Board-2018
28. A protein has the amino acid sequence Ala – Gly –Val – Gly – Leu – Ser as a part of polypeptide chain. In the α -Helix structure, the $-\text{NH}_2$ group of which amino acid will form H-bond with the CO group of Alanine ? What will happen to this hydrogen bond when the protein is denatured ?
Manipur Board-2019
29. Give one example of globular protein.
Assam Board-2019
30. Fill in the blanks :
(e) Protein is a polymer of _____.
MP Board-2018
31. What do you understand by denaturation of Protein.
MP Board-2016
32. Fill in the blanks:
(iii) Haemoglobin is a compound of iron.
MP Board-2014

Section-C : Short Answer	
1. Write short notes on the following :	9. How are proteins classified according to their biological functions? Give functions of each class.
(i) Denaturation of protein (ii) Zwitter ion (iii) Uses of protein	NIOS Board-2015
UP Board 2023	
2. What is peptide bond? How many peptide bonds are present in a tripeptide?	10. What are Hormones ? Give one example for each
Manipur Board 2023	(i) Steroid Hormones (ii) Polypeptide Hormones (iii) Amino Acid derivatives
3. Write a short note on primary and secondary structures of proteins.	Andhra Pradesh Board-2019
UP Board 2023	
4. Differentiate between following :	11. Describe the secondary structure of proteins.
(i) Amylose and Amylopectin (ii) Globular protein and Fibrous protein (iii) Nucleotide and Nucleoside	J&K Board-2019
CBSE-2020	
5. Differentiate between the following :	12. Proteins are biomolecules
(i) Amylose and Amylopectin (ii) Peptide linkage and Glycosidic linkage (iii) Fibrous proteins and Globular proteins	(a) What is denaturation of protein? (b) Match the following:
CBSE-2019	Vitamin A Glucose Starch Zymase Aldohexose Night blindness Enzyme Amylose Fructose
6. (a) Differentiate between the following (give one difference for each) :	Kerala Board-2016
(i) Native proteins and Denatured proteins (ii) α -helix and β -pleated sheet structures of proteins	
(b) Why can Vitamin C not be stored in our body ?	13. Write two differences between globular and fibrous proteins.
CBSE-2019	ISC Board-2017
7. (a) What is the difference between native protein and denatured protein ? (b) Which one of the following is a disaccharide : Glucose, Lactose, Amylose, Fructose (c) Write the name of the vitamin responsible for the coagulation of blood.	14. What is the basic structural difference between starch and cellulose?
CBSE-2019	Assam Board-2014
8. Define the following terms with a suitable example of each :	15. Differentiate between fibrous proteins and globular proteins.
(a) Tertiary structure of protein (b) Essential amino acids (c) Disaccharides	Haryana Board-2016
CBSE-2019	16. Which forces are involved in holding the drugs to the active site of enzymes?
	Assam Board-2020
	17. State the reasons of denaturation of proteins.
	Gujarat Board-2018
	18. What are proteins? Give one example each of fibrous and globular proteins.
	Assam Board-2015
	19. Write any two applications of enzymes.
	MP Board-2015
	20. Write two differences between D.N.A. and R.N.A.
	MP Board-2014
	21. Explain the classification of proteins on the basis of their molecular shape. Give example.
	Nagaland Board-2021
	22.(a)What are globular and fibrous proteins? Give examples.
	Nagaland Board-2018

4. What are enzymes?
All India 2014C

5. What are enzyme catalysts? Give a reaction involving an enzyme catalyst.
Odisha Board-2023

6. Name any four enzyme catalysed reactions.
Andhra Pradesh Board-2019

7. Name the enzyme used in the inversion of cane sugar.
Karnataka Board-2015

8. Name the Hormone which regulates blood sugar level.
Karnataka Board-2019

9. What are hormones ?
Nagaland Board-2017

Section-C : Short Answer

- 1.** Write the equation for the reaction catalysed by the enzyme diastase.

Rajasthan Board-2010

2. Explain in brief:

 - (a) Any two names of enzymes and their functions.
 - (d) Name of two water soluble vitamins and deficiency diseases.

MP Board-2012

Section-E : Long Answer

- 1.** Give the names of two enzymes present in yeast.
Also write equations of the enzyme catalysed reactions.

Rajasthan Board-2013

2. Draw labelled diagram of Bredig's Arc method.

Rajasthan Board-2013

3. What are enzymes? Give two examples with uses

MP Board-2013

E. Nucleic Acids

Section-A : Multiple Choice Questions

- 1. Which base is not present in RNA?**

 - (a) Thymine
 - (b) Adenin
 - (c) Guanine
 - (d) Cytosine

Gujarat Board-2022 (July)

Ans. (a)

Ans. (d)

Ans. (d)

4. Which one is the complementary base of cytosine in one strand to that in other strand of DNA ?

 - (a) Adenine
 - (b) Guanine
 - (c) Thymine
 - (d) Uracil

CBSE-2020

Ans. (b)

- 5.** Nucleic acids are polymers of:

 - (a) D-ribose
 - (b) Amino acids
 - (c) Nucleotides
 - (d) Nucleosides

CBSE-2021

Ans. (c)

6. Which of the following bases is not present in DNA?

 - (a) Thymine
 - (b) Adenine
 - (c) Cytosine
 - (d) Uracil

Gujarat Board-2021

Ans. (d)

7. Which of the following statement is incorrect?

 - (a) 'A' and 'C' are purine bases
 - (b) A and T are joined together by two hydrogen bond in DNA.
 - (c) A, G, C and T bases are present in DNA
 - (d) T and U are pyrimidine bases

Gujarat Board-2019

Ans. (a)

- 8. Which of the following statement is incorrect?**

 - (a) Nucleotide is formed by the attachment of a nucleoside with phosphate ion.
 - (b) Uracil is the derivative of heterocyclic base purine
 - (c) Adenine and Thymine are joined together with two hydrogen bonds
 - (d) DNA reserves the genetic information

Gujarat Board-2016

Ans.(b)

9. Which is the purine base?

- (a) Cytosine
- (b) Guanine
- (c) Thymine
- (d) Uracil

Gujarat Board-2018

Ans. (b)

10. The reason for the double helical structure of DNA is due to the presence of

- (a) van der Waals forces
- (b) dipole-dipole interactions
- (c) hydrogen bonding
- (d) London forces

Meghalaya Board-2019

Ans. (c)

11. Nucleic acids are polymers of

- (a) nucleosides
- (b) globulins
- (c) nucleons
- (d) nucleotides

Nagaland Board-2021

Ans. (d)

12. Which base is not found in DNA?

- (a) Adenine (A)
- (b) Guranine (G)
- (c) Uracil (U)
- (d) Thymine (T)

Jharkhand Board-2023

Ans. (c)

Section-B : Very Short Answer

13. Write down structural difference between DNA and RNA [Any two points]

Gujarat Board 2023 (March)

14. Write the name of the nitrogenous base present only in DNA, but not in RNA.

Karnataka board 2023

15. (a) How can you explain the absence of an aldehyde group in the pentaacetate of D-glucose ?

(b) Name the bases present in RNA. Which one of these is not present in DNA ?

CBSE-2020

16. What is the difference between Nucleotide and Nucleoside ?

CBSE-2019

17. Name the four bases present in DNA. Which one of these is not present in RNA?

All India 2009

18. Name the bases present in RNA. Which one of these is not present in DNA?

Delhi 2011

19. Write the main structural difference between DNA and RNA. Out of the four bases name those which are common to both DNA and RNA.

All India 2011; Delhi 2011

20. Write the structural and functional differences between DNA and RNA.

Delhi 2013C

21. Write the main structural difference between DNA and RNA. Of the two bases, thymine and uracil, which one is present in DNA?

Delhi 2012

22. Write the full forms of DNA and RNA.

Foreign 2012

23. Of the two bases named below, which one is present in RNA and which one is present in DNA?

- (i) Thymine
- (ii) Uracil

Foreign 2012

24. What are the different types of RNA molecules which perform different functions?

Delhi 2013

25. Write down any two differences between nucleoside and nucleotide.

Punjab Board-2017

26. Name the nitrogen base present only in DNA not in RNA.

Karnataka Board-2018

27. How many bases are present in nucleic acids ? Which one of them is not present in DNA ?

Manipur Board-2022

28. What is the difference between a nucleoside and a nucleotide?

Assam Board-2020

29. Name two bases present in DNA.

Assam Board-2017

30. What kind of linkages hold together monomers of DNA?

Assam Board-2016

31. Fill in the blanks :

- (d) Carbylamine test gives only _____ amine.

MP Board-2018

32. Given two difference between D.N.A. and R.N.A.

MP Board-2016

- | | | | |
|---|-------------------------|---|----------------------|
| 33. Name two nucleic acids. | Jharkhand Board-2023 | 12. Write the name of method related with DNA to identify the dead body in any accident? | Rajasthan Board-2016 |
| 34. What are the different types of RNA found in the cells of an organism? State the functions of each type. | Nagaland Board-2017 | 13. Draw labelled diagram for electrophoresis. | Rajasthan Board-2010 |
| Section-C : Short Answer | | | |
| 1. Draw the double strand helix structure of DNA. | Rajasthan Board 2022 | 14. Give four main differences between DNA and RNA. | Rajasthan Board-2010 |
| 2. Differentiate between nucleosides and nucleotides
(b) Give one difference between DNA and RNA. | Uttarakhand Board 2023 | 15. Draw a diagram for the replication of DNA. | Rajasthan Board-2010 |
| 3. (i) What are the hydrolysis products of DNA ?
(ii) What happens when D-glucose is treated with Bromine water ?
(iii) What is the effect of denaturation on the structure of proteins ? | CBSE-2020 | 16. Write the important structural and functional differences between DNA and RNA. | Assam Board-2020 |
| 4. Write any two biological functions of Nucleic acids. | Telangana Board-2017 | 17. Write a short note on heterocyclic base present in nucleic acids. (structure is not required). | Gujarat Board-2018 |
| 5. Define the following terms :
(a) Invert sugar
(b) Native protein
(c) Nucleotide | CBSE-2019 | 18. Name the four bases present in DNA. Which one of these is not present in RNA? | Assam Board-2013 |
| 6. (i) What is the structural difference between a nucleoside and a nucleotide?
(ii) The two strands of DNA are not identical but are complementary. Explain. | Delhi 2010, 2009 | 19. What type of linkages hold together monomer of DNA? | Assam Board-2013 |
| 7. Give preparation and two properties of PHBV. | Gujarat Board-2019 | 20. Write two differences each in the following:
(a) DNA and RNA
(b) α -Amino acid and protein. | MP Board-2012 |
| 8. What are nucleic acids? Mention their important functions. | Chhattisgarh Board-2021 | 21. (a) Mention two important biological functions of nucleic acids.
(b) What happens when D-glucose is heated with HI? (Give equation only) | Meghalaya Board-2021 |
| 9. On the basis of ‘Sugar’ differentiate DNA and RNA. | Rajasthan Board-2017 | Gujarat Board 2023 (March) | |
| 10. Name the products yields from the complete hydrolysis of DNA? | Rajasthan Board-2016 | Ans. (c) | |
| 11. Write the structural formula of sugar moiety in DNA & RNA? | Rajasthan Board-2016 | 2. Amino acids are
(a) acidic
(b) basic
(c) amphoteric
(d) neutral | CBSE-2020 |
| Ans. (a,b*) | | 3. Out of following, which property is shown by aminoacids? | |

F. Amino Acids

Section-A : Multiple Choice Questions

- (a) Dipeptide
(c) Diester

- (b) Glycosidic
(d) Phosphodiester

Gujarat Board-2020

Ans. (a)

16. Proteins are polymers of amino acids, that are connected to each other by
(a) glycosidic linkage
(b) phosphodiester linkage
(c) peptide bond
(d) none of these

Jharkhand Board-2023

Ans. (c)

Section-B : Very Short Answer

1. Answer the following questions.
(a) Give one example of an α -amino acid.
(b) Write the structure of the dipeptide using this example.

ISC Board-2000

2. What are non-essential amino acid ?
Harayana Board 2023
3. What are essential and non-essential amino acids?
Kerala Board 2023

4. Explain the amphoteric behavior of amino acids.
Kerala Board 2023
5. What are essential and non-essential amino acids? Give one example of each type.
All India 2008C

6. Define the following giving one example. Zwitter ion.
All India 2011C; 2008C

7. What are polypeptides?
Delhi 2010

8. Write the name of linkage joining two amino acids.
All India 2013

9. Amino acids show amphoteric behaviour. Why?
All India 2015

10. Define peptisation.
All India 2012

11. Amino acids can be classified into essential amino acids and non essential amino acids.
(a) What is the basis of such classification?
(b) Write one example each for essential and non essential amino acids.

Kerala Board-2013

13. In RNA, the four bases present are Adenine, Guanine, Cytosine and

Haryana Board-2022

14. Although amino group is o- and p-directing in aromatic electrophilic substitution reactions, aniline on nitration gives a substantial amount of m-nitroaniline. Give reason.

Haryana Board-2019

15. What do you mean by peptide linkage ?
Haryana Board-2019
16. What are antihistamines? Give an example
J&K Board-2019

17. Write the general structure of zwitter ion.
Karnataka Board-2015

18. What is Zwitterion?
Chhattisgarh Board-2021
19. Explain the terms:
(i) Electrophoresis
(ii) Dialysis
(iii) Aerosol
Assam Board-2014

20. Write the name of amino acid which is optically inactive.
Rajasthan Board-2020

21. What are essential amino acids?
Assam Board-2018
22. What are non essential amino acids? Give one example.
Assam Board-2017

23. What is peptide bond?
MP Board-2018
24. What is Electrophoresis?
MP Board-2018
25. What is peptization?
MP Board-2014
26. Which α -amino acid is not optically active?
Meghalaya Board-2018

Section-C : Short Answer

1. What is Zwitter ion? Give an example.
Telangana Board-2017
2. Amino acids may be acidic, alkaline or neutral. How does this happen? What are essential and non-essential amino acids? Name one of each type.
All India 2010; Delhi 2010
3. What are essential and non-essential amino acids? Give two examples of each.
All India 2014C

4. Define the following as related to proteins:
- Peptide linkage
 - Primary structure
 - Denaturation
- All India 2015, Delhi 2014, 2006
5. What are amino acids? Give two examples.
- Andhra Pradesh Board-2020
6. Name the following:
- The vitamin responsible for blood coagulation.
 - The linkage that holds the nucleotides together in nucleic acids.
 - The dipolar ion formed by aminoacids in aqueous solution.
 - Water insoluble component on starch.
- Goa Board-2018
7. How is glucose prepared by commercial method? How is peptide linkage formed ?
- Maharashtra board-2019
8. Answer the following equation :
- Write one point of difference between essential and non-essential amino acids.
 - Write a chemical equation to show the action of HI on glucose.
- Goa Board-2019
9. What are essential and non-essential amino acids?
- Assam Board-2014
10. Explain the following terms :
- Peptization
 - Electro-osmosis.
- Jharkhand Board-2020
11. What is the three-letter symbol of the amino acid, Proline?
- Jharkhand Board-2020
12. Define the following terms in relation to proteins:
- Peptide linkage
 - Denaturation
- Haryana Board-2016
13. Explain the terms :
- Electrophoresis
 - Coagulation
- Haryana Board -2016
14. What are antihistamines ? Give an example.
- Manipur Board-2022
15. What are Hormones ? Give one example for each of the following :
- (a) Steroid hormones
- (b) Polypeptide hormones
- (c) Amino acid derivatives
- Andhra Pradesh Board-2018
16. Read the given paragraph and write answers of the following questions.
- Protein is very essential for the growth, development and maintenance of living systems. Proteins are natural polymer of α -amino acids. A definite sequence of amino acids form a specific protein. Two or more than two amino acids bind to give peptide bond. Proteins are polypeptide, which loses its biological activity by physical or chemical changes.
- Explain essential and non-essential amino acid with example.
 - Explain denaturation of protein.
- Rajasthan Board-2018
17. State the classification amino acids.
- Gujarat Board-2018
18. (a) What do you mean by Zwitter ion?
 (b) What essential and non-essential amino acids? Give one example of each.
- Assam Board-2012
19. What are amino acids? How are they classified?
- Or
- Write the biological importance of nucleic acid.
- Nagaland Board-2020
20. (a) What are essential and non-essential amino acids?
 (b) Glycylalanine (Gly-Ala) forms by the following reaction:
- $$\begin{array}{ccc} \text{H}_2\text{N}-\text{CH}_2-\text{COOH} & + & \text{H}_2\text{N}-\text{C}(\text{H}_3)-\text{H}-\text{COOH} \\ & & \downarrow \text{H}_2\text{O}(\text{Alanine}) \\ & & \text{H}_2\text{N}-\text{CH}_2-\text{CO}-\text{NH}-\text{C}(\text{H}_3)-\text{H}-\text{COOH} \\ & & \qquad \qquad \qquad (\text{Gly}-\text{Ala}) \end{array}$$
- Name the type of linkage connecting the two different types of amino acids (Gly and Ala).
- (c) Name the type of proteins present in hair and muscles.
- Meghalaya Board-2021

Section-E : Long Answer

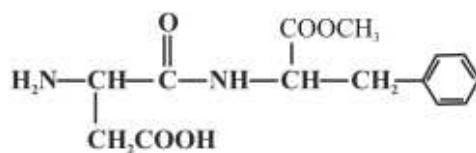
1. Read the given passage and answer the questions number 1 to 5 that follow :

Organic compounds containing amine as functional group are present in a vivid variety of compounds, namely amino acids, hormones, neurotransmitters, DNA, alkaloids, dyes, etc. Drugs including nicotine, morphine, codeine and heroin, etc. which have physiological effects on humans also contain amino group in one form or another. Amines are basic because of the presence of lone pair of electrons on nitrogen. Addition of nitrogen into an organic framework leads to the formation of two families of molecules, namely amines and amides. As chemistry students, we must appreciate the versatility of nitrogen.

 1. What are amino acids?
CBSE-2020
 2. Why are amino acids amphoteric ?
CBSE-2020
 3. Give one point of difference between acidic and basic amino acid.
CBSE-2020
 4. What are essential amino acids ?
CBSE-2020
 5. Name the linkage formed when carboxyl end of one amino acid condensed with amino end of other amino acid.
CBSE-2020
 6. Give scientific reasons for the following:
 - (a) Tryptophan is classified as an essential amino acid.
 - (b) DNA is the chemical basis of heredity.
 - (c) Product of hydrolysis of sucrose is known as invert sugar.

Goa Board-2023
 7. An organic compound A(C_3H_8O) on treatment with Cu dust at 573 K gives B, B does not reduce Fehling's solution but gives a yellow precipitate of compound C with $I_2/NaOH$. Deduce the structures of A, B and C and their IUPAC names.

- (i) (i) The following compound is an example of peptide :



- (r) Write Zwitterion structure of the compound.
- (s) How many amino acids will be obtained on hydrolysis of the compound ?
- (ii) Write equation for the reaction of glucose with periodic acid.

West Bengal Board-2019

8. Give classification of amino acids.
Gujarat Board-2019
9. Answer any SIX of the following :
 - (i) Write balanced chemical equation for the conversion of CrO_4^{2-} to $Cr_2O_7^{2-}$ in acidic medium and $Cr_2O_7^{2-}$ to CrO_4^{2-} in basic medium.
 - (ii) Explain the geometry of $[Co(NH_3)_6]^{3+}$ on the basis of hybridisation.
(Z of Co = 27)
 - (iii) Why ethanol has higher boiling point than ethane ?
 - (iv) Write only reactions for the preparation of benzophenone from benzonitrile.
 - (v) What is the action of p-toluenesulphonylchloride on ethylamine and diethylamine ?
 - (vi) What are amino acids ? Write the correct reaction for formation of peptide bond between amino acids.
 - (vii) Define :
 - (i) Antiseptics
 - (ii) Antioxidants
 - (viii) Explain only reaction mechanism for alkaline hydrolysis of tert-butylbromide.

Maharashtra board-2018
10. Show the formation of a peptide bond with an equation.
Tamilnadu Board, Sep.-2016
11. What is peptide bond? Clarify peptide bond with example of dipeptide.
Gujarat Board-2019

15.

Polymers

A. Classification of Polymers

Section-A : Multiple Choice Questions

1. Which of the following is true structure of nylon 6, 6.

- (a) $\{ \text{NH} - (\text{CH}_2)_6 - \text{NH} - \text{CO} - (\text{CH}_2)_4 - \text{CO} \}_n$
- (b) $\{ \text{CO} - (\text{CH}_2)_5 - \text{NH} \}_n$
- (c) $\{ \text{NH} - (\text{CH}_2)_5 - \text{NH} - \text{CO} - (\text{CH}_2)_4 - \text{CO} \}_n$
- (d) $\{ \text{NH} - \text{CH}_2 - \text{CO} - \text{NH} - (\text{CH}_2)_5 - \text{CONH} \}_n$

Gujarat Board-2022 (July)

Ans. (a)

2. Which of the following is semi-synthetic polymer?

- (a) Polythene
- (b) Buna-S
- (c) Cellulose nitrate
- (d) Starch

Gujarat Board-2022 (July)

Ans. (c)

3. Which polymer is used for non-stick surface coated utensils?

- (a) Nylon
- (b) Polyacrylonitrile
- (c) Teflon
- (d) Bakelite

Gujarat Board-2022 (July)

Ans. (c)

4. Assertion (A): Bakelite is a thermosetting polymer.

Reason (R): On heating, polymeric chain becomes a long and straight chain.

- (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
- (b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
- (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
- (d) Assertion (A) is incorrect, but Reason (R) is correct statement.

CBSE-2020

Ans. (c)

5. Which of the following is a thermosetting plastic?

- (a) Bakelite
- (b) Styrene
- (c) Polythene
- (d) PVC

ISC Board-2017

Ans. (a)

6. Natural rubber is a

- (a) Polyester
- (b) Polyamide
- (c) Polyisoprene
- (d) Polysaccharide

ISC Board-2014

Ans. (c)

7. One of the following is a cross-linked polymer:

- (a) Bakelite
- (b) Glycogen
- (c) Nylon
- (d) Polythene

Odisha Board-2017

Ans. (a)

8. In Buna-S, letter S corresponds to :

- (a) sodium
- (b) sulphur
- (c) styrene
- (d) ethane

Chhattisgarh Board-2023

Ans. (c) :

9. Natural rubber is a polymer of

- (a) isoprene
- (b) acrylonitrile
- (c) vinyl chloride
- (d) tetrafluoroethylene

Odisha Board-2020

Ans. (a)

10. Which one of the following is a biopolymer?

- (a) PHBV
- (b) Nucleic acid
- (c) Poly Glycolic acid
- (d) Poly Lactic acid

NIOS Board-2018

Ans. (b)

11. The monomer of natural rubber is _____.

- (a) Isoprene
- (b) Acrylonitrile
- (c) ε -Caprolactam
- (d) Tetrafluoroethylene

Maharashtra board-2023

Ans. (a)

12. Which of the following is naturally occurring polymer?

- (a) Teflon
- (b) Polythene
- (c) Nylon-6
- (d) Starch

Haryana Board-2016

Ans. (d)

13. Caprolactum is monomer of

- (a) Nylon 6
- (b) Nylon 6, 6
- (c) Bakelite
- (d) Terylene

Jharkhand Board-2023

Ans. (a)

Section-B : Very Short Answer

1. Give two important uses of each of the following :

- (i) Bakelite
- (b) Nylon-6

NIOS Board-2022

2. Neoprene is a _____ rubber.

MP Board 2020

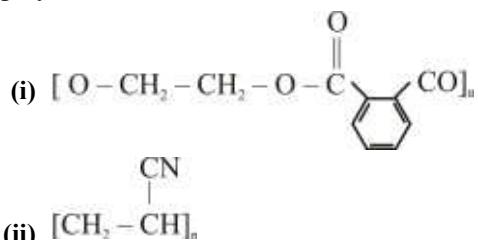
3. Coagulation is the just reverse of _____.

MP Board 2020

4. Is $[-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}-\text{C}(=\text{CN})-\text{]}_n$ a homopolymer or copolymer ?

CBSE-2020

5. Identify the monomers in the following polymers:



CBSE-2020

6. Write the names and structures of monomers in the following polymers :

- (a) Buna-S
- (b) Glyptal
- (c) Bakelite

CBSE-2020

7. Give the structure of the monomer of Teflon.

CBSE-2020

8. Give the structure of the monomer of polypropene.

CBSE-2020

9. Write the names and structures of monomers in the following polymers :

- (a) Bakelite
- (b) Neoprene

CBSE-2020

10. Give the structure of the monomer of PVC.

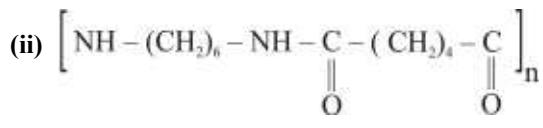
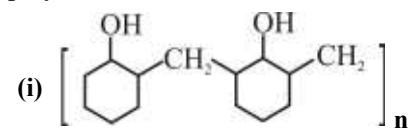
CBSE-2020

11. Give one difference between the following pairs of polymers:

- (a) Homopolymers and Copolymers
- (b) Thermoplastic polymers and Thermosetting polymers

CBSE-2020

12. Identify the monomers in the following polymers :



CBSE-2020

13. Classify the following polymers on the basis of molecular forces:

- (a) Nylon
- (b) Neoprene
- (c) Polyvinyls
- (d) Urea formaldehyde

CBSE-2019

14. Give the monomers of the following polymers?

- (a) Teflon
- (b) Bakelite

ISC Board-2005

15. Give one example each of addition and condensation polymer. Name the monomers in each case.

ISC Board-2008

16. Proteins are polymers of
ISC Board-2001
17. What is step growth polymerisation? Explain the steps involved in this process.
All India 2008C
18. What is the difference between elastomers and fibres? Give one example of each.
All India 2008C
19. Mention two important uses of each of the following:
 (i) Bakelite
 (ii) Nylon-6
Delhi 2011; All India 2010
20. Mention two important uses of each of.
 (i) Nylon-6,6
 (ii) PVC
Foreign 2011
21. Write the structure of repeating monomeric units of
 (i) dacron
 (ii) neoprene
 (iii) polyvinyl chloride
 (iv) teflon
Foreign 2010, 2009; Delhi 2010, 2010C; All India 2010
22. Differentiate between molecular structures and behaviours of thermoplastic and thermosetting polymers. Give one example of each type.
All India 2009
23. Draw the structure of the monomer for each of the following polymers:
 (i) Nylon-6
 (ii) Polypropene
Delhi 2012
24. Write the name of monomers used for getting the following polymers:
 (i) Teflon (ii) Buna-N
Delhi 2014
25. Write the name of monomers used for getting the following polymers:
 (i) Terylene (ii) Nylon-6,6
Delhi 2014
26. Write the name of monomers used for getting the following polymers:
 (i) Bakelite
 (ii) Neoprene
Delhi 2014
27. Write the names and structures of monomers used for getting the following polymers:
 (i) Buna-S
 (ii) Nylon-6,6
All India 2014C
28. Write the name of monomer(s) of neoprene.
All India 2011
29. In nylon-6,6 what does the designation '6,6' mean?
All India 2011, 2010, 2009
Delhi 2009
30. Name the polymer which is used for making non-stick cooking utensils.
31. Is $\text{+CH}_2\text{---CHCl}_2\text{+}$ a homopolymer or a copolymer?
All India 2013
32. Define the term, homopolymerisation giving an example.
Delhi 2012
33. Draw the structure of the monomer for the following polymer: Polypropene
Delhi 2012
34. Which of the following is fibre? Nylon, neoprene, PVC
Delhi 2014
35. Which of the following is a natural polymer?
Buna-S, proteins, PVC
Delhi 2014
36. Based on molecular forces, what type of polymer is neoprene?
Delhi 2014
37. How does a homopolymer differ from a copolymer?
All India 2014
38. Write the distinguishing feature between homopolymers and copolymers.
Delhi 2010, 2008C, Foreign 2008
39. Is $\text{+CH}_2\text{---CH}_(\text{Ph})_2\text{+}$ a homopolymer or a copolymer?
All India 2013, 2008
40. a) Name the monomers used for getting following polymers:
 i) PVC
 ii) Bakelite
 iii) Polystyrene
 b) What is Vulcanisation of rubber?

Karnataka Board-2014

- 18.** Write two uses of each of the following polymers.
 (i) Polypropylene (ii) PVC
 (iii) Nylon-6,6

Delhi 2016C

19. Write the names and structures of the monomers of the following polymers:
 (i) Terylene (ii) Buna-S
 (iii) Neoprene

All India 2015

20. Write the names and structures of the monomers of the following polymers:
 (i) Nylon-6,6
 (ii) PHBV
 (iii) Neoprene

Delhi 2015

21. Write the names and structures of the monomers of the following polymers:
 (i) Terylene
 (ii) Bakelite
 (iii) Buna-S

Foreign 2015

22. Write the structures of the monomers used for getting the following polymers:
 (i) Dacron.
 (ii) Melamine-formaldehyde polymer.
 (iii) Buna-N.

Delhi 2017

23. Write the structures of the monomers used for getting the following polymers:
 (i) Neoprene
 (ii) Melamine-formaldehyde polymer
 (iii) Buna-S

Delhi 2017

24. Write the structures of the monomers used for getting the following polymers:
 (i) Teflon
 (ii) Melamine-formaldehyde polymer
 (iii) Neoprene

All India 2017

25. Write the structures of the monomers used for getting the following polymers:
 (i) Nylon-6, 6
 (ii) Melamine formaldehyde polymer
 (iii) Buna-S

All India 2017

26. When Rohan visited his grandmother in the village, he requested her to use teflon coated utensils for cooking purpose.
 (a) What is the advantage of using teflon coated cookware?
 (b) Write the name and structure of the monomer of teflon.

Goa Board-2023

27. Explain classification of polymer based on their structures.

Gujarat Board-2016

28. How is bakelite made and what is its major use? Why is bakelite a thermosetting polymer?

Manipur Board-2017

29. Name the polymer which is formed by the condensation of 3-hydroxybutanoic acid and 3-hydroxypentanoic acid. Give the structure of the polymer formed.

NIOS Board-2021

30. (a) Differentiate between homopolymers and copolymers. Give one example of each.
 (b) Write the names of monomers and the repeating unit of PHBV.

NIOS Board-2011

31. Write the name of monomer units of Dacron and mention one use of it.

West Bengal Board-2019

32. Classify the polymers depending upon the nature of the repeating structural units. Give one example of each.

NIOS Board-2023

33. Branched chain polymers have low melting point as compared to linear polymers. Why? Give two examples of branched chain polymers.

NIOS Board-2023

34. Write classification of polymers on the basis of structure.

Maharashtra board-2022

35. Write chemical reactions to prepare the following polymers :
 (a) Teflon
 (b) Nylon-6
 (c) Dextron

Maharashtra board-2019

36. Distinguish between thermoplastic and thermosetting polymers by taking one example of each.

Haryana Board-2016

Section-E : Long Answer

1. (a) Name the monomers present in the following polymers,
i) PVC
ii) Neoprene
iii) Nylon-6
(b) Explain vulcanization of rubber.

Karnataka Board-2020

2. a) How is Buna-N prepared? Give equation.
b) Name the monomers of Nylon-6, 6.
c) What are thermosetting polymers?

B. Types of Polymerisation Reactions

Section-A : Multiple Choice Questions

1. _____ is polyester type biodegradable polymer

(a) Glyptal (b) PHBV
(c) Nylon-2-nylon-6 (d) Dacrone

Gujarat Board 2023 (March)

Ans. (b)

2. The monomer of Nylon-6- is-

(a) Ethylene (b) Propene
(c) Styrene (d) Caprolactum

Uttarakhand Board 2023

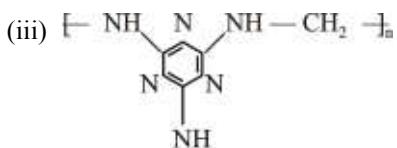
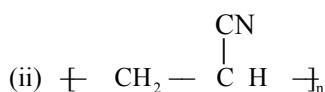
Ans. (d)

38. Define the term polymerization.
All India 2008
39. Give one example of a condensation polymer.
All India 2013
40. What are addition and condensation polymers?
Give one example of each.
Odisha Board-2020
41. How is Nylon- 6,6 prepared?
Odisha Board-2023
42. Name the polymer which is used in making the contact lenses. How is this polymer prepared ?
Manipur Board-2018
43. What is meant by 66 in Nylon -66?
Manipur Board-2018
44. Give monomers name and preparation of Nylon 6, 6.
Punjab Board-2019
45. Name the polymer which is formed by the polymerisatoin of 2-methyl-1, 3-butadiene.
Give the structure of the polymer formed.
NIOS Board-2023
46. Give structure of monomer unit of Nylon-6.
Haryana Board-2019
47. Write chemical equation for the preparation of Buna -N.
Goa Board-2018
48. Write the monomer used for getting the polymer, Glyptal.
Jharkhand Board-2019
49. What is meant by step growth polymerization?
Give an example.
Kerala Board-2019
50. What is the cross linked polymer obtained by the polymerisation of phenol and formaldehyde?
Kerala Board-2018
51. Classify the following as addition polymer or condensation polymer.
(i) Teflon
(ii) Bakelite
Assam Board- 2020, 2014
52. Write any two differences between thermoplastics and thermosetting polymers.
Jharkhand Board-2020
53. Define Thermoplastic and Thermosetting polymers with one example each.
Uttarakhand Board-2019
54. Give the chemical name of Teflon.
Uttarakhand Board-2019
55. Based on the polymerization reaction mode, identify what type of polymers will be formed by the following monomers ?
(i) 1,3-butadiene
(ii) 5-aminopentanoic acid
Manipur Board-2022
56. What is biodegradable polymer ? Give one example.
Andhra Pradesh Board-2018
57. What is PHBV ? How is it useful to man ?
Andhra Pradesh Board-2016
58. Write chemical reaction to prepare, that polymer which is used to preparation of industrial fibers by addition polymerisation of nitrile containing three carbon atom in presence of peroxide catalyst?
Rajasthan Board-2016
59. Write the IUPAC suffix of that functional group of the compound which is used to prepare dacron other.
Rajasthan Board-2016
60. What are thermosetting polymers?
Rajasthan Board-2014
61. Write the names of the monomers of PHBV polymer.
Rajasthan Board-2014
62. How is Nylon 6,6 obtained ? Give reaction.
Rajasthan Board-2014
63. Name the monomers of bakelite.
Assam Board-2016
64. What is LDPE and HDPE?
Nagaland Board-2017

Section-C : Short Answer

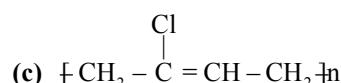
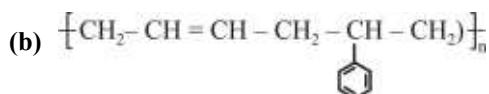
1. A copolymer is prepared using isoprene and propene as monomers. Predict the magnitude o the intermolecular forces present in the polymer.
Manipur Board 2023
2. Write differences–
(i) Low density polythene and High density polythene.
(ii) Homopolymers and copolymers.
(iii) Natural polymers and synthetic polymers.
Rajasthan Board 2023

3. Write the names of monomers in the following polymers :



CBSE-2020

3. Write the names of monomers of the following polymers:



CBSE-2020

4. Answer the following with reason:

- (a) Is $(\text{NH--CHR--CO})_n$, a homopolymer or copolymer?
 (b) Is PVC a condensation or addition polymer?
 (c) Is Bakelite a thermoplastic or a thermosetting plastic?

CBSE-2019

5. Write the structures of monomers used for getting the following polymers:

- (a) Novolac
 (b) Neoprene
 (c) buna-S

CBSE-2019

6. Write the names and structures of the monomers of the following polymers :

- (a) Neoprene
 (b) Bakelite
 (c) PVC

CBSE-2019

7. Write the structures of monomers used for getting the following polymers :

- (a) Nylon-6,6
 (b) Glyptal
 (c) Buna-S

CBSE-2019

8. Answer the following with reason:

- (a) Is $(\text{NH--CHR--CO})_n$, a homopolymer or copolymer?
 (b) Is PVC a condensation or addition polymer?
 (c) Is Bakelite a thermoplastic or a thermosetting plastic?

CBSE-2019

9. Arrange the following polymers in increasing order of their intermolecular forces:

Polyvinylchloride, Neoprene, Terylene

- (b) Write one example each of

- (i) Natural polymer

- (ii) Thermosetting polymer

- (c) What is the significance of numbers 6, 6 in the polymer Nylon-6,6 ?

CBSE-2019

10. Write the structures of monomers used to obtain the following polymers :

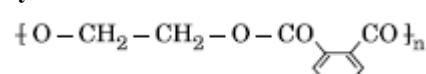
- (a) Neoprene
 (b) PHBV
 (c) Bakelite

CBSE-2019

11. Arrange the following polymers in decreasing order of their intermolecular forces :

Bakelite, Polythene, Buna-S, Nylon-6,6

- (b) Write the monomers of the following polymer :



- (c) What is the structural difference between high density polythene (HDP) and low density polythene (LDP) ?

CBSE-2019

12. (i) What does designation 6,6 in nylon-6,6 polymer mean?

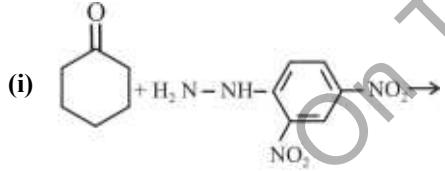
- (ii) Which polymer is obtained when free radical polymerization of chloroprene occurs? Write the structures of the polymers thus obtained.

Foreign 2011

13. What are addition polymers? How are the two types of addition polymers different from each other? Give one example of each type.

Foreign 2011

14. Identify the four groups into which the polymers are classified on the basis of the magnitude of intermolecular forces present in them. To which group or groups do polythene and bakelite belong?
- Foreign 2010
15. Write the structure and one use of each of the following polymers
- (i) PVC
 - (ii) Urea-formaldehyde resin
 - (iii) Bakelite
- All India 2010
16. Give one example each of
- (i) addition polymers
 - (ii) condensation polymers
 - (iii) copolymers
- Delhi 2010
17. Write chemical equation for the synthesis of
- (i) Nylon-6
 - (ii) Nylon-6,6
 - (iii) Polythene
- All India 2009C
18. (i) Differentiate between copolymerization and homopolymerisation. Give one example of each.
(ii) What is the role of benzoyl peroxide in the preparation of polythene?
- Delhi 2013C
19. Differentiate between thermoplastic and thermosetting polymers. Give one example of each.
- All India 2012, 2008; Delhi 2010
20. Explain the following terms giving a suitable example for each.
- (i) Elastomers
 - (ii) Condensation polymers
 - (iii) Addition polymers
- All India 2012
21. Distinguish between addition polymers and condensation polymers. Classify the following into addition and condensation polymers.
- (i) Polythene
 - (ii) PTFE
 - (iii) Polybutadiene
 - (iv) Bakelite
- All India 2011; Foreign 2009
22. Write the names of monomers used for getting the following polymers:
- (i) Teflon
 - (ii) Bakelite
 - (iii) Neoprene
- Delhi 2014C
23. Explain the term ‘copolymerisation’ and give two examples of copolymerization.
- All India 2015C
24. Write the structures of the monomers used for getting the following polymers.
- (i) Nylon-6
 - (ii) Melamine-formaldehyde polymer
 - (iii) Teflon
- Delhi 2017
25. (i) What is the role of t-butyl peroxide in the polymerization of ethene?
(ii) Identify the monomers in the following
 $[NH-(CH_2)_6-NH-CO-(CH_2)_4-CO]_n$
(iii) Arrange the following polymers in the increasing order of their intermolecular force:
Polystyrene, terylene, buna-S
- Delhi 2016
26. Write the mechanism of free radical polymerisation of ethene.
- Delhi 2016
27. Define Natural and Synthetic polymers with example.
- Uttarakhand Board-2020
28. Give chemical equation for preparation of Nylon -6,6 . On the basis of method of polymerization, what type of polymer is it ? Name one such type of polymer.
- NIOS Board-2018
29. Identify the monomers in the following polymeric structure :
-
- NIOS Board-2019
30. Name the polymer obtained by polymerisation of butadiene and styrene in the presence of sodium metal. Give the structure of polymer.
- NIOS Board-2023
31. Name the polymer which is obtained by combination of 2 parts of butadiene and one part of acrylonitrile given its two uses.
- NIOS Board-2019

32. Explain the role of benzoyl peroxide in chain polymerization reaction.
- NIOS Board-2018
33. (a) What type of polymerization forms the polymers whose molecular mass is not an integral multiple of that of the monomer units? Give one example of such polymers and state its monomers.
 (b) Write the names and structures of monomers and the repeating unit of PHBV
- NIOS Board-2016
34. How are polymers classified on the basis of the nature of monomers? Give any four differences between addition and condensation polymerizations.
- NIOS Board-2013
35. What is Zeigler- Natta Catalyst?
- Andhra Pradesh Board-2020
36. Name the polymer obtained by reaction of ethylene glycol and terephthalic acid. Give chemical equation.
- NIOS Board-2022
37. Write the reactions for the formation of nylon 6,6 polymer.
- Maharashtra board-2023
38. Predict the products of the following reactions:
- (i) 
- Assam Board-2014
39. Explain the term addition-polymerization with an example.
- Haryana Board-2017
40. Explain the term co-polymerization with example.
- Haryana Board-2017
41. Explain the difference between polymer nylon 6, 6 and nylon 6.
- Haryana Board-2018
42. Give an example of each of Homopolymer and copolymer.
- Rajasthan Board-2018
43. Write any two differences between addition and condensation polymerisation.
- Rajasthan Board-2015
44. Explain the condensation polymer by an example.
- Rajasthan Board-2013
45. Give one example each of thermoplastic and thermosetting polymers.
- Rajasthan Board-2013
46. Explain the addition polymer by an example.
- Rajasthan Board-2013
47. State the reaction to prepared Teflon and give its two uses.
- Gujarat Board-2018
48. Give definition
 a) Addition homopolymer
 b) Degree of polymerization
- Gujarat Board-2019
49. Give one example of addition homopolymer.
- Assam Board-2017
50. Give one example of addition polymer.
- Assam Board-2016
51. Differentiate the following pairs of polymers based on the property mentioned against each:
 (i) Novolac and Bakelite (structure)
 (ii) Buna-S and Terylene (intermolecular force of attraction).
- Assam Board-2012
52. Give one example of each of
 (i) addition polymer
 (ii) condensation polymer.
- Assam Board-2012
53. What are the monomers of Bakeclite?
- Assam Board-2012
54. What are Polymers? How are they classified on the basis of structure?
 Or
 Give the preparation and two uses of polythene.
- J & K board-2023
55. a. How is nylon-66 obtained? Give one of its uses.
 Or
 b. Explain homopolymers and copolymers with examples.
- Nagaland Board-2020

Section-E : Long Answer

1. What type of polymerization involves unsaturated molecules and requires initiators to catalyze the polymerization? Give one example of such a polymer and its monomer. Does the process involve elimination of any small molecule?

NIOS Board-2015

2. a) Explain the preparation of Nylon-6,6 with equation.
 b) What are thermoplastic polymers? Give an example.
 c) Write the structure of isoprene (2-methyl-1,3-butadiene).

Karnataka Board-2018

3. a) Explain the preparation of Buna-N with equation.
 b) Complete and name the following polymer.
 i) Poly vinyl chloride,
 ii) Natural rubber.
 c) Give an example of biodegradable polymer.

Karnataka Board-2017

4. a) Explain addition polymerization with an example.
 b) Name the monomers used in the manufacture of Nylon-6, 6.
 c) Write the partial structure of Neoprene.

Karnataka Board-2016

5. a) Write the partial structure of
 i) Neoprene
 ii) Terylene (Dacron)
 iii) Nylon-6
 b) Explain the preparation of Buna-N with equation.

Karnataka Board-2015

6. (a) What are (i) addition polymerization and (ii) condensation polymerization ?
 (b) Write any two differences between addition polymerization and condensation polymerization.
 (c) Give one example each of an addition polymer and a condensation polymer.

NIOS Board-2012

7. a) Explain the preparation of Nylon-6,6 with equation.

- b) Write the partial structure of (i) Polythene
 (ii) Neoprene
 c) Name the monomer present in natural rubber.

Karnataka Board-2018

8. a) What is meant by polymerisation ? Name the monomer used in preparation of Polyvinyl Chloride (PVC).
 b) Write partial structure of the following polymers,
 i) Poly propene
 ii) Teflon
 iii) Neoprene.

Karnataka Board-2019

9. Write the monomeric units and one use each of the following polymers :
 (i) PVC
 (ii) Teflon
 (iii) Nylon-6, 6

Kerala Board-2021

10. Answer the following :
 (i) Arrange the following polymers in the increasing order of their intermolecular forces :
 Nylon 6, Neoprene, Polyvinyl Chloride.
 (ii) Write the chemical equation for the preparation of Nylon 6, 6.

Goa Board-2019

11. What is the common name of the polymer obtained by the polymerization of caprolactum? Is it addition polymer or condensation polymer?

ISC Board-2017

12. (a) Vulcanisation is carried out to improve the physical properties of rubber. Explain the process of vulcanization of rubber.
 (b) Classify the following into addition and condensation polymers: PVC, nylon 66, teflon, terylene.

Kerala Board-2020

13. Giving example how can you distinguish between Homopolymers and condensation polymers.

Haryana Board-2016

14. Write difference between Thermoplastic and Thermosetting polymers.

Haryana Board-2018

15. (i) Identify the type of polymer :

-A-A-A-A-A-

(ii) Write the structure of Dacron.

(iii) Define addition polymer

Or

Give preparation and uses of Nylon 66.

J&K Board-2020

16. Define the following with examples

(i) Addition polymerisation

(ii) Condensation polymerisation

Or

What is Nylon-66? Give its preparation and uses.

J & K Board-2021

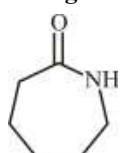
17. Answer the following questions :

(a) Classify the following as addition and condensation polymers :

(b) Give an example of biodegradable aliphatic polyester.

OR

Which of the following polymer can be formed by using the following monomer unit?



Assam Board-2023

C. Biodegradable and Non-Biodegradable Polymers

Section-A : Multiple Choice Questions

1. Detergents are known to pollute rivers and water bodies. However, they can be made biodegradable and pollution free by taking .

- (a) cyclic hydrocarbon chain
- (b) highly branched hydrocarbon chain
- (c) very short hydrocarbon chain
- (d) unbranched hydrocarbon chain

NIOS Board-2018

Ans. (b)

2. Which catalyst is used in manufacture of orlon from acrylonitrile monomer?

- (a) Alkyl mercaptan (b) Ziegler-Natta
- (c) Peroxide (d) Water

Gujarat Board-2019

Ans. (c)

3. Which of the following is monomer of natural rubber?

- (a) Ethylene
- (b) Isoprene
- (c) Chloroprene
- (d) Acrylonitrile

Gujarat Board-2019

Ans. (b)

4. The polymer formed by the condensation of hexamethylenediamine and adipic acid is

- (a) Teflon
- (b) Bakelite
- (c) Dacron
- (d) Nylon-66

ISC Board-2017

Ans. (b)

5. In the following thermosetting polymer is:

- (a) Bakelite
- (b) Polythene
- (c) Polyester
- (d) Buna-N

Haryana Board-2018

Ans. (a)

6. Monomer of Teflon is:

- (a) $\text{CF}_2 = \text{CF}_2$
- (b) $\text{CH}_2 = \text{CHCN}$
- (c) $\text{CH}_2 = \text{CH}_2$
- (d) $\text{C}_6\text{H}_5\text{CH} = \text{CH}_2$

Haryana Board-2018

Ans. (a)

7. Which of the following is not a homopolymer?

- (a) Neoprene
- (b) Natural rubber
- (c) Butyl rubber
- (d) Nitrile rubber

Gujarat Board-2018

Ans. (d) :

8. Which of the following has PDI value = 1.

- (a) Dacron
- (b) SBR
- (c) Cellulose
- (d) PVC

Gujarat Board-2017

Ans. (c)

9. Which monomer is used in preparation of orlon?

- (a) $\text{CF}_2 = \text{CF}_2$
- (b) $\text{CH}_2 = \text{CH-CN}$
- (c) $\text{CH}_2 = \text{CH-Cl}$
- (d) $\text{CH}_2 = \text{CH-OH}$

Gujarat Board-2017

Ans. (b)

10. Bakelite is which type of polymer?

- (a) Cross linked
- (b) Branched
- (c) Linear
- (d) Semi synthetic

Gujarat Board-2018

Ans. (a)

17. Write the name of monomer unit of polymer used in non-stick surface coated utensils.

Rajasthan Board-2018

18. Explain that vulcanised rubber is an elastomer.

Rajasthan Board-2015

19. What are the monomers of Buna-S rubber?

Assam Board-2019

20. Mention one use each of LDP and HDP.

Assam Board-2017

21. Name one biodegradable polymer.

Assam Board-2015

Section-C : Short Answer

1. (a) Write one example each of
(i) Cross-linked polymer
(ii) Natural polymer
(b) Arrange the following in the increasing order of their intermolecular forces:
Terylene, Buna-N, Polystyrene
(c) Define biodegradable polymers with an example.

CBSE-2019

CBSE-2019

3. (a) What are antidepressant drugs ? Give an example.

(b) Name the sweetening agent used in preparation of sweets for a diabetic patient.

(c) Why are detergents non-biodegradable ?

CBSE-2019

4. Write the structures of monomers used to obtain the following polymers:

 - (a) Buna-S
 - (b) Glyptal
 - (c) Nylon-6

CBSE-2019

5. What are biodegradable polymers? Give an example of such a polymer and mention its uses.

Delhi 2009C

6. (a) Give an example of biodegradable polymer.

(b) Match the following correctly:

Polymer	Monomer
a. Natural Rubber	i. 1, 3 Butadiene Styrene
b. Neoprene	ii. 1, 3 Butadiene acrylonitrile
c. Buna-N	iii. Chloroprene
d. Buna-S	iv. Isoprene

Assam Board-2022

- 7. Match the following :**

(a) Alyl Chloride	(1) $\text{CH}_2 = \text{CHCl}$
(b) Benzyl Chloride	(2) CCl_2F_2
(c) Vinyl Chloride	(3) $\text{CH}_2 = \text{CHCH}_2\text{Cl}$
(d) Freon	(4) $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$

Uttarakhand Board-2020

- 8. How can Terylene be prepared?
Tamil Nadu Board-2011**

9. What are biodegradable polymers? Given two examples.

NIOS Board-2019

- 10.** Give reactions for the preparation of Bakelite.
Gujarat Board-2019

11. What are Bio-degradable polymers? Write the structural formulae of a biodegradable polymer.

J&K Board-2019

12. Polymers are of different types

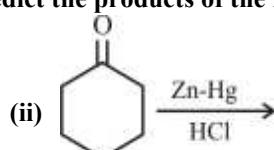
(a) Identify the thermoplastic polymer from the following

(i) Bakelite (ii) Nylon-6,6
(iii) Neoprene (iv) PVC

(b) What is biodegradable polymers? Write an example.

Kerala Board-2016

- 13. Predict the products of the following reactions:**



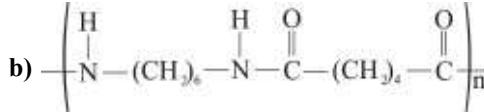
Assam Board-2014

14. Define thermoplastic polymers.
Assam Board-2014
15. What is biodegradable polymer? Give one example.
Haryana Board-2017
16. Write the monomers used for preparing following polymers:
 (i) Glyptal
 (ii) Nylon-6, 6
Haryana Board-2017
17. What are Biodegradable and Non – biodegradable detergents ?
Haryana Board -2016
18. How is Dacron obtained from its monomers.
Haryana Board-2016
19. Differentiate between biodegradable and non-biodegradable polymers.
Rajasthan Board-2020
20. Give two example of Bio degradable polymers.
Rajasthan Board-2017
21. Give the name of both monomers used in formation of terylene.
Rajasthan Board-2017
22. Write the chemical formula of Teflon and P.V.C.
Rajasthan Board-2017
23. Give the names of monomers used for obtaining Buna-N.
Rajasthan Board-2013
24. Write the equation of preparation of synthetic rubber.
Rajasthan Board-2013
25. Give the names of monomers used for obtaining dacron.
Rajasthan Board-2013
26. Match the polymers given in Column A with their specialties given in Column B:

Column A	Column B
(a) Nylone 66	(i) Thermoplastic
(b) Bakelite	(ii) Elastomer
(c) PVC	(iii) Thermosetting
(d) Natural rubber	(iv) Fibres

 Rajasthan Board-2010
27. Give the name of monomer unit of PVC and one use of PVC.
Rajasthan Board-2010
28. Give preparation and uses of Nylon 6,6.
Gujarat Board-2017
29. Write name of monomers of Glyptal and structure of Glyptal.
Gujarat Board-2018
30. Give the equation for preparation of biodegradable polymer of polyester class. Which properties of monomers are there in this compound?
Gujarat Board-2019
31. Mention the structural difference between thermoplastic polymer and thermosetting polymer.
Assam Board-2018
32. (a) What is vulcanisation of rubber?
 (b) What is the role of sulphur on vulcanisation of rubber?
Assam Board-2015
33. (a) Name the monomers of bakelite.
 (b) What is the primary feature necessary for a monomer to make it useful in a condensation polymerization reaction?
 (c) What is meant by copolymerization? Give one example of a copolymer.
Assam Board-2013
34. What are biodegradable and non-biodegradable polymers? Give one example each.
Nagaland Board-2018

Section-E : Long Answer

1. How is Buna-s rubber prepared ? Give its use.
Tamil Nadu Board-2011
2. a) How is neoprene prepared? Give equation.
 b) 
- c) Give an example for synthetic biodegradable polymer.
- Karnataka Board-2020
3. a) How is neoprene prepared?
 b) What are bio-degradable polymers? Give example.
 c) What is vulcanization? (2+2+1)
Karnataka Board-2015
4. a) Name the monomers used in the preparation of Nylon 6,6.
 b) Explain Vulcanization of rubber.

- c) Give an example for biodegradable polymer.
Karnataka Board-2016

5. What is Vulcanization of rubber? Give its main advantage.
Haryana Board-2016

6. Differentiate between the monomers of Buna-N and Buna-S.
Haryana Board-2018

7. What are biodegradable and non-biodegradable polymers? Give two examples each.
Gujarat Board-2018

8. Give the chemical reaction for the preparation of Nitrile rubber. Also mention its two properties and two uses.
Gujarat Board-2018

9. State the monomers present in terylene and draw their structures.
Gujarat Board-2020

10.(a) What is a biodegradable polymer?
(b) Classify the following into addition and condensation polymers :
Terylene, Bakelite, Polyvinyl chloride,
Polythene

D. Molecular Mass of Polymers

Section-A : Multiple Choice Questions

1. In which of the following molecules the bond angle is minimum ?

 - (a) CH_4
 - (b) H_2O
 - (c) NH_3
 - (d) NH_4^+

NIOS Board-2022

Ans. (b)

- 2. Which option is correct for synthetic polymer?**

 - (a) $\overline{M_n} = \overline{M_w}$
 - (b) $\overline{M_n} \geq \overline{M_w}$
 - (c) $\overline{M_w} > \overline{M_n}$
 - (d) $\overline{M_w} < \overline{M_n}$

Gujarat Board-2019

Ans. (c)

Section-B : Very Short Answer

1. Name the polymer which is used for making non-stick utensils and describe the preparation of it.

Manipur Board 2020

2. What is PDI (Poly Dispersity Index) ?

Andhra Pradesh Board-2019

3. What is polydispersity index for a polymer?

Rajasthan Board-2019

4. Write the formula to determine ‘weight average molecular weight’ of polymers.

Rajasthan Board-2018

5. Give one use of high density polythene (HDP).

Assam Board-2018

Section-C : Short Answer

- 1.** Explain with reason how the following properties of p-block elements trend while moving from left to right in a period-

 - Atomic radius
 - Ionisation energy
 - Electronegativity

Uttarakhand Board 2023

2. Give reasons of the following

 - H_2O is liquid while H_2S is gas.
 - Phosphorus forms PCl_5 while Nitrogen does not forms NCl
 - The size of Cl^- ion is greater than the size of Cl atom

Uttarakhand Board 2023

3. Natural rubber is the polymer of

(a) Acrylonitrile	(b) Isoprene
(c) Vinyl chloride	(d) Chloroprene

Ans. (b)

Section-D : Case Based Study

1. Shyam went to a grocery shop to purchase some food items. The shopkeeper packed all the items in polythene bags and gave them to Shyam. But Shyam refused to accept the polythene bags and asked the shopkeeper to pack the items in paper bags. He informed the shopkeeper about the heavy penalty imposed by the government for using polythene bags. The shopkeeper promised that he would use paper bags in future in place of polythene bags.

Answer the following :

- (a) Write the values (at least two) shown by Shyam.
 - (b) Write one structural difference between low-density polythene and high-density polythene.
 - (c) Why did Shyam refuse to accept the items in polythene bags ?
 - (d) What is a biodegradable polymer ? Give an example.

UP Board-2018

E. Importance of Polymers

Section-A : Multiple Choice Questions

- 1. The material used as coating for non-stick pans is**

(a) polystyrene (b) terylene
(c) teflon (d) PVC

ISC Board-2001

Ans. (c)

- A polymer used in paints is –**

 - (a) Nomex
 - (b) Thiokol
 - (c) Saran
 - (d) Glyptal

(d) Gryptal
Maharashtra board-2018

Ans. (d)

3. Name the polymerization product formed by the condensation reaction between phenol and formaldehyde

 - (a) Bakelite
 - (b) Melamine formaldehyde
 - (c) Nylon
 - (d) Dacron

Kerala Board-2022

Ans. (a)

Jharkhand Board-2023

Ans. (b)

Section-B : Very Short Answer

1. Name the polymer which is used for making electrical switches and combs. CBSE-2020
 2. Name the polymer which is used for making non-stick utensils. CBSE-2020
 3. What are polyamide? Give one example of a polyamide and name its monomers. ISC Board-2011
 4. Give two examples of natural polymers. ISC Board-2009
 5. Name the subgroups into which polymers are classified on the basis of magnitude of intermolecular forces. Delhi 2011; foreign 2010; All India 2009
 6. What is PHBV ? How is it useful to man? Telangana Board-2023

Telangana Board-2023

7. Explain the term copolymerization and give two examples. Haryana Board-2019

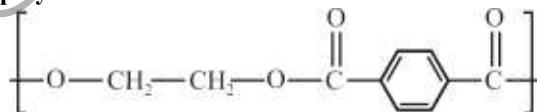
8. What is the use of polyvinyl chloride ? Jharkhand Board-2018

9. Identify the monomer of the polymer represented as $[-\text{CH}_2 - \text{CHCl}-]_n$. Manipur Board-2022

10. What does PVC stands for? Mention its one use. Assam Board-2016

Assam Board-2016

Section-C : Short Answer



- (iii) Arrange the following polymers in increasing order of their intermolecular forces.
Terylene, polythene, neoprene.

All India 2016

4. Write names of the monomers used for getting the polymers
(a) Bakelite
(b) Glyptal

Andhra Pradesh Board-2020

5. When Rohan visited his grandmother in the village, he requested her to use teflon coated utensils for cooking purpose.
(a) What is the advantage of using teflon coated cookware?
(b) Write the name and structure of the monomer of teflon.

Andhra Pradesh Board-2020

5. When Rohan

3. When Rohan visited his grandmother in the village, he requested her to use teflon coated utensils for cooking purpose.

 - What is the advantage of using teflon coated cookware?
 - Write the name and structure of the monomer of teflon.

Goa Board-2019

6. How is Nylon-66 obtained? Give one of its uses.
Nagaland Board-2018

Section-E : Long Answer

- 1. How will you prepare ‘Buna-N’ and Nylon 66? Mention their uses.**

Tamil Nadu Board-2015

16.

Chemistry in Everyday Life

A. Drugs and Their Classification

Section-A : Multiple Choice Questions

1. Penicillin is an

- (a) Antibiotic
- (b) Antipyretic
- (c) Antiseptic
- (d) Analgesic

Uttarakhand Board 2023

Ans. (a)

2. Aspirin is:

- (a) Sedative
- (b) Antipyretic
- (c) Anti-biotic
- (d) Antiseptic

Odisha Board-2017

Ans. (b)

3. Which class of chemical compounds is used to relieve pain?

- (a) Analgesic
- (b) Antipyretic
- (c) Antiseptic
- (d) Tranquilizer

Odisha Board-2020

Ans. (a)

4. The compound found in some stony deposit in kidneys is

- (a) potassium oxalate
- (b) oxalic acid
- (c) potassium succinate
- (d) calcium oxalate

Tamil Nadu Board-2011

Ans. (d)

5. Compound which is used as medicine for Asthma and Whooping cough is

- (a) Benzyl acetate
- (b) Ethyl acetate
- (c) Benzyl benzoate
- (d) Benzyl formate

Tamil Nadu Board-2011

Ans. (c)

6. Use of chloropicrin (CCl_3NO_2) is as

- (a) explosive
- (b) dye
- (c) anaesthetic
- (d) sterilizing agent

Tamil Nadu Board-2011

Ans. (d)

7.is involved in the process of blood coagulation

- (a) Fats and oils
- (b) Cephalin
- (c) Glycolipids
- (d) Lecithins

Tamil Nadu Board-2011

Ans. (d, b*)

8. Which of the following is an antihistamine drug?

- (a) Ciprofloxacin
- (b) Chloroquine
- (c) Chloramphenicol
- (d) Chlorpheniramine maleate

Odisha Board-2023

Ans. (d)

9. Out of the following substance which is not an antioxidant.

- (a) Butylated hydroxyanisole
- (b) Citric acid
- (c) Ascorbic acid
- (d) Sorbic acid salt

Gujarat Board-2019

Ans. (c)

10. Which of the following reduces fever?

- (a) Analgesic
- (b) Antiseptic
- (c) Antibiotic
- (d) Antipyretic

Haryana Board-2016

Ans. (d)

11. An antifertility drug is _____

- (a) Novestrol
- (b) Histamine
- (c) Veronal
- (d) Equanil

Maharashtra board-2018

Ans. (a)

12. A broad spectrum antibiotic is :

- (a) Paracetamol
- (b) Ranitidine
- (c) Aspirin
- (d) Chloramphenicol

Haryana Board -2016

Ans. (d)

13. Which of the following drug reduces pain?

- (a) Analgesic
- (b) Antipyretic
- (c) Antibiotic
- (d) Antiseptic

Haryana Board -2016

Ans. (a) :

14. Dettol is used as:

- (a) Disinfectants
- (b) Antiseptic
- (c) Analgesic
- (d) Antallergic

Haryana Board-2016

Ans. (b)

15. Aspirin is an—

[1]

- (a) Antipyretic
- (b) Antibiotics
- (c) Antiseptic
- (d) None of these

Uttarakhand Board-2019

Ans. (a)

16. Barbituric acid is an example of

- (a) Tranquilizer
- (b) Antibiotic
- (c) Analgesic
- (d) Antacid

Jharkhand Board-2023

Ans. (a)

17. Which drug is useful for the patient of heart disease by preventing co-agulation of blood?

- (a) Quinine
- (b) Penicillin
- (c) Aspirin
- (d) Paracetamol

Gujarat Board-2016

Ans. (c)

18. Which of following is an antacid?

- (a) Ranitidine
- (b) Aspirin
- (c) Naproxen
- (d) Penicillin

Haryana Board-2016

Ans. (a)

19. Which of the following drugs is analgesic drug?

- (a) Barbiturates
- (b) Penicillin
- (c) Ranitidine
- (d) Paracetamol

Gujarat Board-2017

Ans. (d)

20. Which is anti fertility drug?

- (a) Mestranol
- (b) Veronal
- (c) Luminal
- (d) Seconal

Gujarat Board-2018

Ans. (a)

21. Which alloy is used by dentist to fill the cavity in the tooth?

- (a) Hg+Ag+Cu
- (b) Hg+Ag+Sn+Cu+Zn
- (c) Hg+Ag+Cu+Sn
- (d) Ag+Sn+Cu+Zn

Gujarat Board-2019

Ans. (b)

22. Which drug is non-narcotic and analgesic?

- (a) Morphine
- (b) Aspirin and paracetamol
- (c) Penicillin
- (d) Veronal

Gujarat Board-2019

Ans. (b)

23. Which drug is used in preventing platelet coagulation?

- (a) Zantac
- (b) Aspirin
- (c) Phenelzine
- (d) Bithional

Gujarat Board-2020

Ans. (b) :

24. Antibiotics which are effective against a single organism or disease, are referred as _____.

- (a) Broad spectrum antibiotics
- (b) Limited spectrum antibiotics
- (c) Narrow spectrum antibiotics
- (d) Gram positive antibiotics

Gujarat Board-2020

Ans. (b)

25. Which of the following protein is water insoluble?

- (a) Insulin
- (b) Myosin
- (c) Albumin
- (d) All of the them

Gujarat Board-2020

Ans. (b)

26. Tincture Iodine is :

- (a) Aqueous solution of I_2
- (b) Solution of I_2 in aq. KI
- (c) Alcoholic solution of I_2
- (d) Aqueous solution of KI

Haryana Board-2016

Ans. (a)

Section-B : Very Short Answer

- | | |
|--|---|
| <p>1. How are antiseptics different from disinfectants? Is chlorine in low concentration (0.2 to 0.41 ppm) antiseptic or disinfectant?
Manipur Board 2020</p> <p>2. What are analgesics? Classify them.
Manipur Board 2023</p> <p>3. How do antiseptics differ from disinfectants ? Name a substance which can be used as a disinfectant as well as antiseptic.
CBSE-2020</p> <p>4. Name the sweetening agent used in the cooking of sweets for a diabetic patient.
CBSE-2020</p> <p>5. Name the compound which is added to soap to provide antiseptic properties.
CBSE-2020</p> <p>6. Which one of the following is a narcotic analgesic?
Penicillin, Codeine, Ranitidine
CBSE-2020</p> <p>7. Which one of the following is an antidepressant drug ?
Chloramphenicol, Luminal, Bithional
CBSE-2020</p> <p>8. Pick out the odd one from among the following compounds on the basis of their medicinal properties :
Equanil, Luminal, Bithional, Seconal
CBSE-2020</p> <p>9. What type of chemical substances are used in sleeping pills ?
CBSE-2020</p> <p>10. Give one point of difference between the following :
(a) Tranquillizers and Analgesics
(b) Antiseptics and Disinfectants
CBSE-2020</p> <p>11. Define the following terms:
(a) Tranquillizers
(b) Antiseptic
CBSE-2020</p> | <p>12. How do antiseptics differ from disinfectants ? Name a substance which can be used as a disinfectant as well as an antiseptic.
CBSE-2020</p> <p>13. Why are medicines more effective in colloidal state?
CBSE-2019</p> <p>14. (a) Differentiate between antiseptic and disinfectant. Give one example of each.
(b) Why do we require artificial sweetening agents ?
CBSE-2019</p> <p>15. Mention one use of the following drugs:
(i) Ranitidine. (ii) Paracetamol.
(iii) Tincture of iodine.
All India 2008</p> <p>16. What are antibiotics? Distinguish between narrow spectrum and broad spectrum antibiotics. Classify the following into bactericidal and bacterostatic antibiotics: Tetracycline, penicillin.
All India 2008C</p> <p>17. What are analgesics medicines? How are they classified and when are they commonly recommended for use?
Delhi 2010; All India 2010</p> <p>18. Answer the following questions.
(i) Why should medicines not be taken without consulting doctor?
(ii) What is meant by broad spectrum antibiotics?
(iii) What are the main constituents of dettol?
All India 2014C</p> <p>19. Name a broad spectrum antibiotic and state two diseases for which it is prescribed.
All India 2009C</p> <p>20. What is meant by a broad spectrum antibiotic?
Delhi 2008C</p> <p>21. Explain the following terms with an example for each:
(i) Antifertility drugs.
(ii) Antibiotics.
Delhi 2010; All India 2010C</p> |
|--|---|

22. What are biodegradable and non-biodegradable detergents? Give one example of each class.
Foreign 2012; Delhi 2008
23. Describe the following types of substance giving suitable examples: Antiseptics.
All India 2010C; Delhi 2009
24. Write the name of an antacid which is often used as medicine.
Foreign 2009
25. Name a substance that can be used as an antiseptic as well as disinfectant.
Delhi 2008; All India 2008C
26. Define the following
(i) Limited spectrum antibiotics
(ii) Tranquillisers
Delhi 2017
27. What is meant by a broad spectrum antibiotics?
Foreign 2011
28. What are limited spectrum antibiotics? Give one example.
Delhi 2013C
29. What is the cause of a feeling of depression in human beings? Name a drug which can be useful in treating depression.
All India 2012
30. What is meant by narrow spectrum antibiotics?
Foreign 2012
31. Dettol is an example of which type of drug?
Uttarakhand Board-2020
32. How do antiseptics differ from disinfectants? Give an example in each case.
Odisha Board-2023
33. How does aspirin act as an analgesic?
Manipur Board-2017
34. What are antiseptics? Give example.
Karnataka Board-2014
35. a) Give an example for non narcotic analgesics.
b) Why the use of aspartame is limited to cold foods and soft drinks?
Karnataka Board-2020
36. Give an example for i) Non –narcotic analgesics
ii) Antiseptics
Karnataka Board-2017
37. What are anti-fertility drugs? Give an example.
Karnataka Board-2016
38. Mention a drug which can act, both as an analgesic as well as an antipyretic. Name an artificial sweetening agent.
Karnataka Board-2014
39. What are (a) antipyretics and (b) analgesics ? Give two examples of each.
NIOS Board-2012
40. What are analgesics ? How are they classified ?
Andhra Pradesh Board-2019
41. What are antiseptics ? Give examples.
Andhra Pradesh Board-2019
42. What are Analgesics ?
Punjab Board-2019
43. What are antacids ?
Punjab Board-2017
44. Write briefly with one example.
(a) Disinfectants
(b) Antacids.
Jharkhand Board-2018
45. Give an example of antibiotic.
Jharkhand Board-2018
46. What are analgesics? Name the non-narcotic analgesic used in the prevention of heart attacks.
Karnataka Board-2020
47. What are antibiotics? Give an example.
Karnataka Board-2015
48. Give an example each for antifertililgy drug and antiseptics.
Karnataka Board-2017
49. What are antacids? Write the main constituents of dettol.
Maharashtra board-2019
50. (a) What are drugs?
(b) Write an example for a drug classified based on its chemical structure .
Kerala Board-2018

51. Write the structure, IUPAC name and one use of DDT.
- Chhattisgarh Board-2020
52. (a) Write what is meant by broad spectrum antibiotics.
 (b) Write how antiseptics differ from disinfectants.
- Assam Board-2014
53. Give an example of Tranquillizer.
- Jharkhand Board-2020
54. What are antibiotics ? Give example.
- Andhra Pradesh Board-2018
55. What are antibiotics ? Give example.
- Andhra Pradesh Board-2016
56. Write name of the hormone secreted by thyroid gland.
- Rajasthan Board-2019
57. Identified the type of following drugs and write its types.
 (a) Valium (b) Cimetidine
- Rajasthan Board-2017
58. Why should not medicines be taken without consulting doctors?
- Assam Board-2020
59. Name one chemical responsible for the antiseptic property of Dettol.
- Assam Board-2019
60. What is Chemotherapy?
- Assam Board-2018
61. Name a substance which can act as non-narcotic analgesic.
- Assam Board-2016
62. Give one example each of the following:
 (a) A non-narcotic analgesic
 (b) An artificial sweetner
 (c) A food preservative chemical
- Assam Board-2015
63. (i) Name one chemical responsible for the antiseptic property dettol.
 (ii) Name one substance that can act both as analgesic as well as antipyretic.
- Assam Board-2012
64. Fill in the blanks:
 (d) The substance which _____ acidity of stomach is called
- MP Board-2013
65. Write chemical name of one Antifertility Drug.
- MP Board-2012
66. Give two uses of DDT.
- J&K Board-2020
67. What are analgesics and tranquilizers ? Give one example each.
- Nagaland Board-2017
68. Give one example of each of the following: (any three)
 (i) A tranquilizer
 (ii) An antidepressant drug
 (iii) Narcotic Analgesic
 (iv) An antiseptic
- Assam Board-2017
69. (i) What is DDT ?
 (ii) Complete the reaction :

$$\text{CH}_3\text{CH}_2\text{OH} + \text{SOCl}_2 \xrightarrow{\text{pyridine}} ? + ? + ?$$
- Nagaland Board-2017

Section-C : Short Answer

1. Give any one example of following–
 (i) Antibiotics
 (ii) Narcotic analgesics
 (iii) Antacids
- Rajasthan Board 2023
2. (a) What class of drugs are used as sleeping pills?
 (b) What is used to control the cause of acidity in the stomach?
 (c) What makes some of the detergents non-biodegradable in nature?
- CBSE-2020
3. What are anti-biotics? Give example.
- Telangana Board-2017
4. What are anti-fertility drugs? Give example.
- Telangana Board-2017
5. Differentiate between the following :
 (a) Antiseptics and Disinfectants
 (b) Antacids and Antihistamines
 (c) Soaps and Detergents
- CBSE-2019
6. (a) What type of drug is used in sleeping pills ?
 (b) What type of detergents are used in toothpastes ?
 (c) Why the use of alitame as artificial sweetener is not recommended ?
- CBSE-2019

7. Define the following terms with a suitable example in each :
- Broad-spectrum antibiotics
 - Disinfectants
 - Cationic detergents
- CBSE-2019
8. (i) What type of drug is used in sleeping pills ?
(ii) What type of detergents are used in toothpastes ?
(iii) Why the use of alitame as artificial sweetener is not recommended ?
- CBSE-2019
9. (a) Which class of drugs is used as sleeping pills ?
(b) Between sodium hydrogen carbonate and magnesium hydroxide, which is a better antacid and why ?
(c) What makes some of the detergents biodegradable in nature ?
- CBSE-2019
10. Define the following terms:
(a) Antacids
(b) Antiseptics
(c) Artificial sweeteners
- CBSE-2019
11. (a) Which one of the following drugs is an antibiotic :
Equanil, Ofloxacin, Aspirin, Luminal
(b) Why is use of aspartame limited to cold food and drinks?
(c) Why do we require artificial sweetening agents?
- CBSE-2019
12. Define the following with suitable example of each :
(a) Antiseptics
(b) Non-narcotic analgesics
(c) Cationic detergents
- CBSE-2019
13. Define the following terms with a suitable example of each :
(a) Tranquilizers
(b) Antibiotics
(c) Non-ionic detergents
- CBSE-2019
14. Define the following:
(i) Cationic detergents
(ii) Broad spectrum antibiotics
(iii) Tranquillisers
- All India 2017
15. What is the prime cause of depression? Give an example of antidepressant drug.
- Assam Board-2022
16. How do antiseptics differ from disinfectants? Name a substance which can be used as antiseptics as well as disinfectants.
- Uttarakhand Board-2020
17. What are hormones? Give one example for each of the following:
(a) Steroid hormones
(b) Polypeptide hormones
(c) Amino acid derivatives
- Telangana Board-2023
18. What are analgesics? How are they classified? Give one example for each.
- Telangana Board-2023
19. What is the name of a local anaesthetic and an antimalarial medicine.
- Chhattisgarh Board-2023
20. Define the following with one example each:
(a) Antipyretics
(b) Antibiotics
- Manipur Board-2017
21. Write short notes on:
(I) Antacids
(II) Analgesics
- Tamil Nadu Board-2016
22. (a) What type of polymer is used for post-operative stitches and for personal hygiene products? Name any one such polymer. Write its method of preparation giving chemical equation involved.
(b) Identify the monomers of the following polymer and write their structures. Write two uses of the polymer :

$$-\text{NH}-(\text{CH}_2)_6-\text{NHCO}-(\text{CH}_2)_4-\text{CO}-\}_{n}$$
- NIOS Board-2014
23. Differentiate between antipyretics and analgesics.
- NIOS Board-2014

24. What is the difference between an antiseptic and a disinfectant? Give two examples of each.
NIOS Board-2013
- 25.(i) Chemotherapy is a term found in medical terminology. What is chemotherapy?
(ii) Synthetic detergents are classified into three categories.
(a) What are the three categories?
(b) To which of the above categories of synthetic detergents, does the liquid dish washing detergents belong?
Kerala Board-2013
26. Briefly explain different types of neurologically active drugs and give example for each type.
Kerala Board-2019
27. Different drugs have different therapeutic action in our body. Write the therapeutic action of the following drugs in our body.
(a) Analgesics
(b) Antibiotics
(c) Tranquilizers
Kerala Board-2016
28. Match the classes of drugs given in Column I with their action given in Column-II
- | | Column - I | | Column-II |
|-----|---------------|-------|--------------------------------------|
| (a) | Analgesics | (i) | Applied to inanimate objects |
| (b) | Disinfectants | (ii) | Pain killing effect |
| (c) | Antibiotics | (iii) | Treatment of acidity |
| (d) | Tranquilizers | (iv) | Applied to diseased skin surface |
| | | (v) | Treatment of stress |
| | | (vi) | Inhibit the growth of microorganisms |
- Goa Board-2019
29. Analgesics and antibiotics are drugs having different therapeutic actions. Define each class of drugs.
Kerala Board-2020
30. Name a substance which can be used as an antiseptic and disinfectant at different concentrations.
Kerala Board-2020
31. How do antiseptics differ from disinfectants? Explain.
Chhattisgarh Board-2020
32. Identify one analgesic and one antacid from the following:
Aspirin, Chloramphenicol, Cimetidine, sulphanilamide.
Assam Board-2014
33. What are antibiotics? Give two examples.
Haryana Board-2017
34. Why are synthetic detergents better than soaps?
Haryana Board -2016
35. Different drugs have different therapeutic action in our body. Write the therapeutic action of the following drugs in our body:
(i) Analgesics
(ii) Antibiotics
(c) Antihistamines
Kerala Board-2015
36. Compare the narcotic and non-narcotic analgesic drugs in terms of effectiveness and side effects.
Manipur Board-2019
37. Name the following:
(a) An analgesic that also prevents platelet coagulation.
(b) The class of detergents with germicidal property.
(c) The artificial sweetener with the highest sweetness value.
(d) An antibiotic with bactericidal effect.
Goa Board-2019
38. What is meant by the term antibiotics? Give two examples.
Haryana Board-2018
39. What are broad spectrum drugs? Give one example.
Haryana Board-2018
40. (a) Aspirin should not be taken in empty stomach, why?
(b) Write any two differences between dyes and pigments.
Rajasthan Board-2018

- | | | |
|-----|---|------------------|
| 41. | How drugs can be classified according to different criteria. Write the name of each?

Rajasthan Board-2016 | Assam Board-2019 |
| 42. | How antihistamines works? Give an example of any antihistamine?

Rajasthan Board-2016 | Assam Board-2019 |
| 43. | Write the structural formula of any sleep producing barbiturate?

Rajasthan Board-2016 | Assam Board-2018 |
| 44. | What tranquilizers? Write the name of any mild tranquilizer?

Rajasthan Board-2016 | Assam Board-2016 |
| 45. | Write any one difference between broad spectrum and narrow spectrum antibiotics.

Rajasthan Board-2015 | Assam Board-2013 |
| 46. | Write any one difference between antiseptics and disinfectants.

Rajasthan Board-2015 | Assam Board-2013 |
| 47. | What is anionic detergent ? Write an example.

Rajasthan Board-2015 | Assam Board-2013 |
| 48. | What are non-narcotic analgesics ? Write an example.

Rajasthan Board-2015 | Assam Board-2013 |
| 49. | Explain the following :

(a) Disinfectants
(b) Food preservatives
(c) Tranquilizers.

Rajasthan Board-2014 | MP Board-2018 |
| 50. | Why do diabetic persons require artificial sweetening agents?

Rajasthan Board-2013 | MP Board-2017 |
| 51. | Give the uses of radioactive isotopes in medicine.

Tamilnadu Board, Sep.-2016 | MP Board-2017 |
| 52. | What is antiseptic? Give an example.

Tamilnadu Board, Sep.-2016 | MP Board-2017 |
| 53. | What are antioxidants? give example.

Tamilnadu Board, March-2016 | MP Board-2017 |
| 54. | What is meant by the term 'broad spectrum antibiotics'? Explain with an example.

Assam Board-2020 | MP Board-2017 |
| 55. | What are non narcotic analgesic drugs? Give two examples.

Gujarat Board-2018 | MP Board-2017 |
| 56. | Sleeping pills are recommended to patient suffering from sleeplessness but it is not advisable to take them without consulting the doctor. Justify.

Gujarat Board-2018 | MP Board-2017 |

14. Name the substance which can act both analgesic and antipyretic as well. How does it help heart patients? What precautions must be taken while taking it?

J & K Board-2021

15. (a) What are tranquilizers?

(b) What are broad-spectrum antibiotics?

(c) Name a substance that can be used as an antiseptic as well as disinfectant.

Meghalaya Board-2019

B. Dyes and Pigment

Section-A : Multiple Choice Questions

1. Bordeaux mixture contains

(a) $\text{AgNO}_3 + \text{HNO}_3$

(b) $\text{ZnSO}_4 + \text{H}_2\text{SO}_4$

(c) $\text{CuSO}_4 + \text{Ca}(\text{OH})_2$

(d) $\text{KMnO}_4 + \text{HCl}$

Tamil Nadu Board-2011

Ans. (c)

2. Which compound is reacted with Benzene diazonium chloride salt in azo coupling reaction to produce orange dy?

(a) Aniline

(b) Phenol

(c) N-Methyl Aniline

(d) Chloro Benzene

Gujarat Board-2020

Ans. (b) :

Section-B : Very Short Answer

1. What are synthetic detergents?

Why are these more advantageous than soap?

UP Board 2019

2. Explain the cleansing action of soaps.

CBSE-2020

3. How do antiseptics differ from disinfectants?

Name a substance that can be used as an antiseptic as well as a disinfectant.

All India 2012; foreign 2010; Delhi 2008

4. Explain the following terms giving an example of each:

(i) Antacids

(ii) Sweetening agents.

Delhi 2011; Foreign 2011

5. Differentiate between disinfectants and antiseptics. Give one example of each group.

All India 2012

6. What is tincture of iodine and what is it used for?

All India 2011

7. What are dyes ? Why do dyed articles appear to have a characteristic colour ?

NIOS Board-2012

8. a) Name the monomer present in the following polymer:

i) Nylon – 6

ii) Natural rubber

iii) Neoprene

- b) What are co-polymers? Give an example.

Karnataka Board-2017

9. What are antacids? given one suitable example.

Assam Board-2016

Section-C : Short Answer

1. Write any three characteristics of days.

Tamil Nadu Board-2011

2. What are acid basic dyes? On what type of fabrics they are applied?

NIOS Board-2015

3. What is the characteristic structural unit of azo dyes? Write the name and structure of one such dye.

NIOS Board-2014

4. This white pigment has a high opacity and binding power, has double spreading power than that of white lead and has no tendency to chalking. Write the name and formula of this pigment, and also give its composition.

NIOS Board-2013

5. Write note on insect repellent.

MP Board-2018

C. Chemicals in Food

Section-A : Multiple Choice Questions

1. Which of the following is food preservatives?

(a) Ascorbic acid (b) Citric acid

(c) Sodium benzoate (d) Tetrazine

Gujarat Board-2018

Ans. (c)

2. A compound used as pistachio flavour in ice cream is —
- vanillin
 - acetophenone
 - muscone
 - butyraldehyde

Maharashtra board-2019

Ans. (b)

3. Which is not an artificial sweetener?
- Saccharin
 - Alitame
 - Sugar
 - Sucrolose

Haryana Board-2016

Ans. (c)

4. Choose the correct option for uses of dinitrogen gas.

(P) For preservation of biological substances in liquid state and food materials

(Q) As oxidizing agent in rocket fuel

(R) in respiration

- Only P
- Q and R
- P and R
- P and Q

Gujarat Board-2016

Ans. (b)

5. Which of the following is used as a food preservative?

- Sucralose
- Salts of sorbic acid
- Citric acid
- Ascorbic acid

Gujarat Board-2018

Ans. (b) :

Section-B : Very Short Answer

1. Explain antioxidants in food.

Gujarat Board-2022 (July)

2. What are analgesics? Give an example for narcotic analgesics.

Karnataka board 2023

3. Define the following terms with a suitable example in each :

- Bacteriocidal antibiotics
- Food preservatives

CBSE-2020

4. What are artificial sweetening agents? Give two examples. Name the sweetening agent used in the preparation of sweets for a diabetic patient.

Delhi 2009C

5. Mention the action of the following on the human body in bringing relief from a disease.
- Brompheniramine.
 - Aspirin.
 - Equanil.

HOTS; All India 2011C

6. What are the following substances? Give one example of each one of them.
- Tranquillisers.
 - Food preservatives.
 - Synthetic detergents.

Delhi 2012

7. Explain the following terms with one example in each case:

- Food preservatives.
- Enzymes.
- Detergents.

Delhi 2012, 2011; All India 2010

8. Describe the following giving one example for each:
- Detergents.
 - Food preservatives.
 - Antacids.

All India 2011; Delhi 2011

9. Explain the following terms with one suitable example for each:
- A sweetening agent for diabetic patients.
 - Enzymes.
 - Analgesics.

Delhi 2011; All India 2009

10. Describe the following and give one example of each.
- Sweetening agents.
 - Food preservatives.
 - Antibiotics.

Delhi 2014C

11. What is meant by the following terms? Explain with an example for each.
- Target molecules as used in medicinal chemistry.
 - Food preservatives.
 - Non-ionic detergents.

All India 2014C

12. Explain the following terms with a suitable example for each:

(i) Disinfectants.	24. Name (i) Artificial sweetening agent used only in cold food (ii) Anionic detergent. Karnataka Board-2017
(ii) Antacids.	
(iii) Food preservatives. Foreign 2014	25. Give an example of food preservative. Jharkhand Board-2019
13. Answer the following: (i) Why is the use of aspartame limited to cold foods and drinks? (ii) How do antiseptics differ from disinfectants? (iii) Why do soaps not work in hard water? All India 2014	26. _____ is an artificial sweetner which is unstable at cooking temperature. Kerala Board-2018
14. (i) Which one of the following is a food preservative? Equanil, morphine, sodium benzoate (ii) Why is bithional added to soaps? (iii) Which class of drugs is used in sleeping pills? Delhi 2013	27. What are artificial sweetening agents ? Give example. Andhra Pradesh Board-2016
15. What are food preservatives? Name two such substances. All India 2012	28. Explain the following : (a) Antiseptics (b) Artificial sweetening (c) Antacids. Rajasthan Board-2014
16. State a reason of the following statement: The use of the sweetener aspartame is limited to cold foods and drinks. Foreign 2012	
17. Define the following and give one example: Tranquillisers. Delhi 2012; All India 2010C	
18. What is food preservation? Give an example. Karnataka Board-2014	1. Write a short note on food preservative. MP Board 2020
19. What is the role of following chemicals in food? i) Saccharin ii) Sodium benzoate Karnataka Board-2016	2. Explain artificial sweetening agents by any two examples. Rajasthan Board 2023
20. What is the role of these as food additives? i) Sodium benzoate. ii) Aspartame. Karnataka Board-2015	3. Give one point of difference between the following: (a) Cast Iron and Pig Iron (b) Hydraulic Washing and Liquation (c) Leaching and Roasting CBSE-2019
21. Explain saponification of oils/fats with equation. Karnataka Board-2015	4. What are pesticides? What are different types of pesticides? Name one of each type. Odisha Board-2017
22. What are food preservatives ? Punjab Board-2017	5. Explain the process of saponificaiton. Write chemical equation involved. NIOS Board-2021
23. i) What are tranquilizers? ii) Name the first popular artificial sweetening agent. Karnataka Board-2016	6. Name two most familiar antioxidants used as food additives. Andhra Pradesh Board-2020
	7. Define antiseptics and disinfectants. Haryana Board-2017
	8. How food preservatives works. Give an example of food preservative? Rajasthan Board-2016
	9. Why are chemicals added to food ? Write any two reasons. Rajasthan Board-2015

- | | | |
|--|----------------------|--|
| 10. Why is artificial sweetening agent, Aspartame used only in soft drinks and cold foods? | Rajasthan Board-2015 | 3. Write short notes on chemicals in food.
Tamilnadu Board, Sep.-2016 |
| 11. What are artificial sweetners? Write any four names. | | 4. Describe the following with suitable examples |
| | MP Board-2018 | (i) Artificial sweeteners
(ii) Antioxidants |
| (i) Give two names of Artificial sweeters. | | |
| (ii) Give definition of antibiotic and one example. | | J & K Board-2021 |
| (iii) Give definition of antihistamine drug with name and uses. | | |
| | MP Board-2016 | |
| 13. What is preservative? Give the name and formula of any two preservatives. | | D. Cleansing Agent |
| | MP Board-2013 | |
| | | Section-A : Multiple Choice Questions |
| | | 1. Compound (A) on heating gives an oxide. This oxide is used for white washing when mixed with water (A) is : |
| | | (a) $\text{Ca}_2(\text{PO}_4)_3$
(b) CaCO_3 |

Section-D : Case Based Study

- 1.** Read the given paragraph and write answers of the following questions.

Chemicals have special importance in various field of daily life as-in food, in soap and detergents. Chemicals are used in food materials for preservation, to enhance appeal and to increase its nutritive quality in them. Chemical substance which are added to the food materials to prevent their spoilage and retain their nutritive value for long times are called food preservatives. Artificial sweeteners are those chemical compounds which are used to give sweetening effect to the food materials. Diabetic patients are advised to used sachharin in place of sugar.

- (a) Why chemicals are added in food materials?
 - (b) Write name of any two food preservatives.
 - (c) Why diabetic patients are advised to used saccharin.

Rajasthan Board-2019

Section-E : Long Answer

- 1. What are artificial sweetening agents? Give two examples.**

Tamil Nadu Board-2015

2. Write name of a food preservative. How does it preserve food?

Rajasthan Board-2013

Tamil Nadu Board-2015

2. Write name of a food preservative. How does it preserve food?

Rajasthan Board-2013

- 3. Write short notes on chemicals in food.**

Tamilnadu Board, Sep.-2016

4. Describe the following with suitable examples

(i) Artificial sweeteners

(ii) Antioxidants

J & K Board-2021

D. Cleansing Agent

Section-A : Multiple Choice Questions

1. Compound (A) on heating gives an oxide. This oxide is used for white washing when mixed with water (A) is :

 - (a) $\text{Ca}_2(\text{PO}_4)_3$
 - (b) CaCO_3
 - (c) $\text{Ca}(\text{OH})_2$
 - (d) CaSO_4

NIOS Board-2021

Ans. (c)

2. Which of the following solution is used as washing solution for eyes to free them from microorganisms?

 - (a) 2-3% Iodine solution
 - (b) 0.2% Phenol solution
 - (c) 1% Phenol solution
 - (d) Dilute aqueous solution of Boric acid

Gujarat Board-2018

Ans. (d) :

3. Which type of detergent is LAS?

 - (i) Anionic
 - (ii) Cationic
 - (iii) Biosoft
 - (iv) Biohard
 - (a) (i) and (iv)
 - (b) (i) and (iii)
 - (c) (ii) and (iii)
 - (d) (ii) and (iv)

Gujarat Board-2019

Ans. (b)

- 4. Which is not a glyceride?**

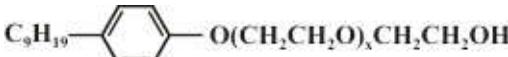
 - (a) Fat
 - (b) Oil
 - (c) Phospholipid
 - (d) Soap

MP Board-2018

Ans. (d)

Section-B : Very Short Answer

- | | |
|--|---|
| <p>1. Why do soaps not work in hard water?
Gujarat Board 2023 (March)</p> <p>2. Why soap does not work in hard water?
Karnataka board 2023</p> <p>3. Mention the role of sodium benzoate in food.
Karnataka board 2023</p> <p>4. Differentiate between Soap and Synthetic Detergents.
Uttarakhand Board 2023</p> <p>5. Define the following terms with a suitable example in each :
 (a) Tranquilizers
 (b) Anionic detergent
CBSE-2020</p> <p>6. Define the following terms with a suitable example of each :
 (a) Analgesics
 (b) Cationic detergent
CBSE-2020</p> <p>7. Name the class of the synthetic detergent which is used in toothpaste.
CBSE-2020</p> <p>8. Differentiate on the basis of chemical composition between cationic and anionic detergents. Also give one example of each category.
CBSE-2020</p> <p>9. Explain the following terms with one suitable example in each case:
 (i) Cationic detergents.
 (ii) Enzymes.
 (iii) Antifertility drugs.
Delhi 2010</p> <p>10. Explain the following terms with an example of each:
 (i) Cationic detergents.
 (ii) Broad spectrum antibiotics.
 (iii) Tranquilisers.
All India 2010C</p> <p>11. Explain the following with one suitable example for each case:
 (i) Cationic detergents.
 (ii) Food preservatives.
 (iii) Analgesics.</p> | <p>12. What are the following substances? Give one example of each type.
 (i) Antacid.
 (ii) Non-ionic detergents.
 (iii) Antiseptics.
Delhi 2009</p> <p>13. What are anionic detergents? How are they prepared? Write their two main uses.
Delhi 2009C</p> <p>14. Answer the following questions:
 (i) Why do soaps not work in hard water?
 (ii) What are the main constituents of dettol?
 (iii) How do antiseptics differ from disinfectants?
Delhi 2011, 2009</p> <p>15. (i) What class of drugs is ranitidine?
 (ii) If water contains dissolved Ca^{2+} ions, out of soaps and synthetic detergents, which will you use for cleaning clothes?
 (iii) Which of the following is an antiseptic?
 0.2% phenol or 1% phenol
All India 2013</p> <p>16. Discuss two ways in which drugs prevent the attachment of natural substrate on active sites of an enzyme.
Delhi 2008C</p> <p>17. Define the following:
 (i) Cationic detergents
 (ii) Broad spectrum antibiotics
 (iii) Tranquilisers
All India 2017</p> <p>18. Define the following:
 (i) Anionic detergents
 (ii) Broad spectrum antibiotics
 (iii) Antiseptics
Delhi 2017</p> <p>19. Define the following:
 (i) Anionic detergents.
 (ii) Limited spectrum antibiotics
 (iii) Antiseptic.
All India 2017</p> <p>20. Define the following
 (i) Cationic detergents
 (ii) Narrow spectrum antibiotics
 (iii) Disinfectants
Delhi 2017</p> |
|--|---|

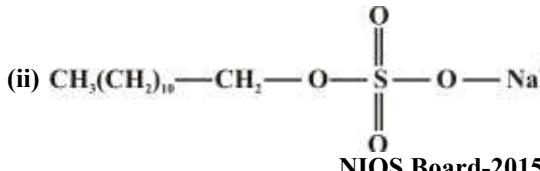
21. (i) Give two examples of macromolecules that are chosen as drug targets.
(ii) What are antiseptics? Give an example.
(iii) Why is use for aspartame limited to cold foods and soft drinks?
All India 2014
22. (i) Define antihistamine with an example.
(ii) Which one of the following drugs is an antibiotic? Morphine, equanil, chloramphenicol, aspirin.
(iii) Why is use of aspartame limited to cold foods and drinks?
Delhi 2014C
23. Explain the following with one example for each:
(i) Anionic detergents.
(ii) Chemotherapy.
All India 2010C
24. Label the hydrophilic and hydrophobic parts in the following molecule of a non-ionic detergent.
- 
- Identify the functional groups present in the molecule.
Delhi 2010c
25. State the reason in each of the following cases:
(i) Soaps do not work well in hard water.
(ii) Synthetic detergents are better than soaps.
Foreign 2011, 2009
26. Explain the cleansing action of soap. Why do soaps not work in hard water?
All India 2012
27. Explain the following terms with suitable examples:
(i) Cationic detergents.
(ii) Anionic detergents.
Delhi 2013C
28. Describe and illustrate with an example, a detergent.
All India 2012
29. Name the main constituents of dettol.
Delhi 2010C
30. Explain the cleansing action of soap. Why do soaps not work in hard water?
All India 2012
31. What are the advantages of synthetic detergents over soaps. (any two points)
Manipur Board-2018
32. a) Why detergents with straight chain of hydrocarbons are preferred over branched chain hydrocarbon?
b) Give one example for detergent with straight chain hydrocarbon.
Karnataka Board-2020
33. i) What are anionic detergents?
ii) What is the role of saccharin in food?
Karnataka Board-2019
34. What are cationic detergents? Give an example.
Karnataka Board-2018
35. What are anionic detergents? Give an example.
Karnataka Board-2017
36. Why detergents containing linear alkylbenzene sulphonate are better detergents over branched counterparts?
NIOS Board-2016
37. Soaps and detergents are soluble in water as well as oil. Explain.
NIOS Board-2013
38. Differentiate between cationic and anionic detergents giving suitable examples.
Haryana Board-2019
39. Why soaps do not work in hard water?
Karnataka Board-2016
40. What is saponification? Write the equation to get sodium stearate by this method.
Karnataka Board-2019
41. Differentiate between Soap and Synthetic Detergents.
[2] Uttarakhand Board-2019
42. Write the difference between a soap and a synthetic detergent.
Andhra Pradesh Board-2018
43. Explain the terms:
(i) Emulsification
Assam Board-2016
44. Cleansing action of soap based on which principle?
MP Board-2013

Section-C : Short Answer

1. Why soap does not work in Hard Water?
MP Board 2020
2. (a) Pick out the odd one from the following on the basis of their medicinal properties : Equanil, Seconal, Bithional, Luminal
(b) What type of detergents are used in dishwashing liquids ?
(c) Why is the use of aspartame limited to cold foods ?
CBSE-2019
3. (i) Why bithional is added in soap ?
(ii) Why magnesium hydroxide is a better antacid than sodium bicarbonate ?
(iii) Why soaps are biodegradable whereas detergents are non-biodegradable ?
CBSE-2019
4. Define the following terms:
(a) Tranquilizers
(b) Ant-acids
(c) Analgesics
CBSE-2019
5. (i) Broad-spectrum antibiotics
(ii) Disinfectants
(iii) Cationic detergents
CBSE-2019
6. (a) Soap is a weak antiseptic. What may be added to soap to improve its antiseptic action?
(b) Name the class of drugs used to kill or inhibit a wide range of Gram positive and Gram negative bacteria
(c) Which of the following is a food preservative? Sodium stearate, Sodium benzoate, Sodium lauryl sulphate
CBSE-2019
7. Describe the following with a example–
(a) Artificial sweeteners
(b) Food Preservatives
Uttarakhand Board-2020
8. Explain Anionic and Cationic detergents.
Gujarat Board-2016
9. (a) Why is bithional added to soap ?
(b) What is tincture of iodine ? Write its one use.
(c) Among the following, which one acts as a food preservative ? Aspartame, Aspirin, Sodium Benzoate, Paracetamol
UP Board-2018
10. What is saponification ? How is it done ? Write chemical equations involved.
NIOS Board-2019
11. Answer the following questions about (A) $C_{12}H_{25}-O-SO_3Na$ and (B) $C_{17}H_{35}COONa$.
(a) Which one is a detergent ?
(b) Which one can be used for washing of clothes only with soft water ?
- (c) Is $(C_{12}H_{25}-O-SO_3)_2Ca$ water soluble or not ?
(d) Identify the lipophilic part in B.
NIOS Board-2022
12. What is saponification? Give one example.
NIOS Board-2018
13. What are artificial sweetening agents? Give an example.
Andhra Pradesh Board-2020
14. Give classification of synthetic detergents with example.
Gujarat Board-2019
15. (a) Give the example of broad spectrum antibiotics.
(b) What type of detergents are used for dish washing?
Goa Board-2018
16. (i) Distinguish anionic detergents and cationic detergents with suitable examples.
(ii) Name any one antioxidant used in food materials.
Kerala Board-2022
17. Why do soaps not work in hard water?
Haryana Board-2016
18. Name the following:
(a) A compound added to soaps to impart antiseptic properties.
(b) The class of drugs used in the treatment of mental disorders.
(c) The process by which esters of fatty acids are converted to soap.
(d) A broad spectrum antibiotic.
Goa Board-2019
19. Write any two difference between soap and detergent.
Rajasthan Board-2017
20. Why do soaps not work in hard water?
Rajasthan Board-2016
21. Give the name and formula of cationic detergents.
Rajasthan Board-2013
22. Explain how detergent is superior than soap.
Rajasthan Board-2010
23. Explain cationic detergent with example.
Rajasthan Board-2010
24. Why do we require artificial sweetening agent?
Assam Board-2016
25. (i) Mention one advantage of the use of synthetic detergent over soap.
(ii) What is tincture of iodine? Mention one use of tincture of iodine.
Assam Board-2015
26. Why do soaps not work in hard water?
Nagaland Board-2020

Section-E : Long Answer

1. Label the hydrophilic and lipophilic parts in the following molecules of soaps and detergents :



NIOS Board-2015

2. Write the chemical equation for saponification. Also give the limitations of soap.

Gujarat Board-2018

3. What are artificial sweetening agents? Give two examples.

Haryana Board-2016

4. Explain the cleansing action of soap and detergents.

Nagaland Board-2018

E. Importance and Uses

Section-A : Multiple Choice Questions

1. Which detergent is used in toothpaste?

- (a) Cationic detergent (b) Non-ionic detergent
(c) Anionic detergent (d) (a) and (b) both

Gujarat Board-2022 (July)

Ans. (c)

2. Which of the following is used as disinfectant?

- (a) Soframycin
(b) 0.2% phenol
(c) Equanil
(d) Morphine

Jharkhand Board-2023

Ans. (b)

F. Crystal Lattices and Unit Cells

Section-B : Very Short Answer

1. When fruits and vegetables that have dried up are placed in water, they slowly swell and return to original form. Why? Will a temperature increase accelerate the process ? Explain.

CBSE-2020

2. What are food preservatives? Give an example.

CBSE-2019

3. Where does the water present in the egg go after boiling the egg?

Delhi 2012C

4. Describe the four segment of environment.

NIOS Board-2015

5. Name the protein present in hair.

Karnataka Board-2014

6. What are Freons?

Karnataka Board-2014

- Give an example each for

- a) Artificial sweetening agents
b) Narcotic analgesics.

Karnataka Board-2018

8. Define feedstock with reference to petrochemicals. Write the names of two feedstocks used in petrochemical industry.

NIOS Board-2016

9. Why a rocket fuel must carry an oxidizing agent along with the fuel?

NIOS Board-2016

10. Write two components of environment.

NIOS Board-2016

11. State two main sources of pollutants with suitable examples.

NIOS Board-2016

12. Mention two water plants by which mercury pollution can be reduced.

NIOS Board-2016

13. What is meant by BOD? On what three factors does BOD value of an aquatic system depend?

NIOS Board-2016

14. Define the term 'background radiation'. Write any four preventive measures for radiations.

NIOS Board-2016

15. What are contraceptives ?

NIOS Board-2015

16. What is meant by the term 'biomagnification'?

NIOS Board-2014

17. Write any two anthropogenic sources of lead. Mention any two toxic effects of lead.

NIOS Board-2014

18. Differentiate between primary and secondary pollutants. Give one example of each.

NIOS Board-2014

19. What are greenhouse gases? How do they cause global warming? Mention any two serious effects of global warming.

NIOS Board-2014

20. Name the segment of environment that contains—

- (a) Metals;
(b) lakes.

NIOS Board-2013

21. Natural sources of this toxic heavy metal are volcanic activity, spray from oceans and forest fires. Identify the heavy metal. List any three of its toxic effects on humans.

NIOS Board-2013

22. Identify the rays that are used in CT scan. What types of radiations are these?

- Give any two anthropogenic sources of these types of radiations.

NIOS Board-2013

23. Name the pollutants that cause ozone layer depletion, and explain the process.
NIOS Board-2013
24. What are the parameters that indicate water pollution? Give two examples of each. Give any one source and two effects of inorganic pollutants.
NIOS Board-2013
25. What are petrochemicals ?
NIOS Board-2012
26. Which type of radiation is damaging for human health ?
NIOS Board-2012
27. Define a ‘heavy metal’. Name any two toxic heavy metals.
NIOS Board-2012
28. What is ‘environment’? Define the term ‘anthropogenic pollutants’.
NIOS Board-2012
29. List the damaging effects each of (i) SO₂ and (ii) NO₂ in plants and animals.
NIOS Board-2012
30. What are contraceptives? Give two examples.
NIOS Board-2011
31. Name two feedstocks used in petrochemical industry.
NIOS Board-2011
32. Define radioactive pollution.
NIOS Board-2011
33. Differentiate between primary and secondary pollutants giving one example of each.
NIOS Board-2011
34. Name the mercury derivative which is very toxic to humans. List any one reason for its high toxicity.
NIOS Board-2011
35. Which noble gas can diffuse through rubber and glass?
Karnataka Board-2020
36. Write the molecular formula of novestrol.
Maharashtra board-2019
37. Define : Green chemistry. Write two advantages of nanoparticle and nanotechnology.
Maharashtra board-2023
38. How is SO₂ an air pollutant ?
Chhattisgarh Board-2022
39. Metal present in chlorophyll is —
Kerala Board-2021
40. What is Formalin? Write its use. [1]
Uttarakhand Board-2019
41. In modern diving apparatus, a mixture of He and O₂ is used. Why ?
Andhra Pradesh Board-2016
42. What is an ammonolysis ?
Nagaland Board-2021
43. What is dialysis ?
Nagaland Board-2021

44. Name any one antacid.

Jharkhand Board-2023

Section-C : Short Answer

1. Give the uses of Freon 12 and Chloroform.
Uttarakhand Board-2020
2. Give reasons :
(i) FeCl₃ solution is used to stop the bleeding.
(ii) Catalyst is more effective as powdered state.
Chhattisgarh Board-2023
3. Match the following :
- | | Group A | | Group B |
|-------|--------------------------|-----|-----------------------------|
| (i) | Corrosion | (A) | Lanthanides and Actinides |
| (ii) | Gold sol. | (B) | Used in treatment of cancer |
| (iii) | Radon | (C) | Purple of Cassius |
| (iv) | <i>f</i> -block elements | (D) | Barbituric acid |
| (v) | Tranquilizers | (E) | Hydrated ferric oxide |
- Chhattisgarh Board-2023
4. Why do double-base solid propellants not need any separate oxidizer? Explain with the help of one example.
NIOS Board-2015
5. What are clays? Give the names and chemical formulae of three common clays.
NIOS Board-2015
6. Which of the following are present in traces in the atmosphere? Water vapour, carbon monoxide, hydrogen, carbon dioxide.
NIOS Board-2015
7. What are such electromagnetic radiations called which have high energy and cause ionization of atoms and molecules of the medium through which they pass? Give one example and any two anthropogenic sources of such radiations.
NIOS Board-2015
8. Chlorofluorocarbons damage a layer in stratosphere. What name is given to this damage? What is the primary effect of this damage? Give any two of its consequences.
NIOS Board-2015
9. (a) Why are plasticizers and binders added to paints? Write one function of each component.
(b) What are analgesic medicines? Write two types of analgesic medicines and write one characteristic of each which differentiates them from each other.
NIOS Board-2016
10. What are the main raw materials used in the manufacture of Portland cement ? Explain the process of setting and hardening of cement. How is water proof cement obtained ?
NIOS Board-2015

11. What are the sources and effects of the following water pollutants :
 (i) Pesticides and insecticides
 (ii) Chlorine compounds
 (iii) Mercury
 (iv) Sediments
 NIOS Board-2015
12. Define radioactive pollution. Name (i) any three natural sources and (ii) three manmade or anthropogenic sources of radioactive pollution. What were the two accidents in the past which led to high radioactive leakage.
 NIOS Board-2015
13. Name any one gas which forms acid rain. What is the effect of acid rain on marble statues ?
 NIOS Board-2015
14. Define eutrophication. Why does aquatic life get killed in an eutrophied pond?
 NIOS Board-2015
15. List the raw materials used in the manufacture of portland cement. What is meant by (a) setting of cement and (b) hardening process?
 NIOS Board-2014
16. Explain the two types of radiations. Which of these is damaging to human health and why? Describe any two anthropogenic sources of these radiations.
 NIOS Board-2014
17. Name a primary petrochemical obtained from reformed naphtha which is used for the manufacture of synthetic detergents.
 NIOS Board-2014
18. What is Portland cement ? List the various raw materials required for the manufacture of Portland cement.
 NIOS Board-2012
19. Define 'water pollution'. List any three (a) anthropogenic sources and (b) parameters of water pollution.
 NIOS Board-2012
20. List different raw materials used in the manufacture of glass. What is meant by tempering of glass? Write two examples of substances used as colourant for glass.
 NIOS Board-2011
21. What are paints? Which constituent of paints is used to (a) protect the film and (b) decrease the cost of the paint?
 NIOS Board-2011
22. Define water pollution. Describe the source and effect of each of the following water pollutants:
 (a) Oil and grease
 (b) Acids and alkalies
 (c) Radioactive materials
 NIOS Board-2011
23. What is ozone hole? How is it caused? Describe any two serious damaging effects of ozone depletion on the (a) physical environment and (b) humans and plants.
 NIOS Board-2011
24. Define green chemistry. Write two disadvantages of nanotechnology.
 Maharashtra board-2022
25. Explain dehydrohalogenation reaction of 2-chlorobutane. Write use and environmental effect of CFC.
 Maharashtra board-2023
26. What are the important uses and environmental effects of D.D.T.?
 J & K Board-2021

Section-E : Long Answer

1. Name the following:
 (a) An analgesic that also prevents platelet coagulation.
 (b) The class of detergents with germicidal property.
 (c) The artificial sweetener with the highest sweetness value.
 (d) An antibiotic with bactericidal effect.
- OR
- Name the following:
 (a) A compound added to soaps to impart antiseptic properties.
 (b) The class of drugs used in the treatment of mental disorders.
 (c) The process by which esters of fatty acids are converted to soap.
 (d) A broad spectrum antibiotic.
2. What are germicides? How are these classified? Differentiate between these classes and give their uses. Iodine belongs to which one of these classes? Give one example of a germicide which can be used as both the types under different conditions. Mention those conditions.
 NIOS Board-2015
3. What is heavy metal? Give two examples each of the heavy metals that are (a) essential for organisms and (b) toxic heavy metals. Give two natural sources of heavy metals. How do heavy metals reach the ecosystem?
 NIOS Board-2015
4. (a) What is an antiseptic? Give one example.
 (b) Name one narcotic and one non-narcotic analgesic.
 (c) Name any two main categories of food additives.

Meghalaya Board-2018